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FOSSIL CORALS FROM LESSER ANTILLES AND PORTO RICO.

MONOGRAPHS OF STYLOPHORIDAE, ORBICELLIDAE,  
ASTREOPORA, ACTINACIS, GONIOPORA.

By

Thomas Wayland Vaughan.

III



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ACTINACIS, GONIOPORA.

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Species of Corals described or listed

from the West Indies by Duncan,

showing the location of the types or original specimens, the species contained in collections in the United States: Museum of Comparative Zoology, the Academy of Natural Sciences of Philadelphia, the United States National Museum, and the collection of T. H. Aldrich; also those collected by R. T. Hill and J. W. Spencer, with notes on the synonymy.

G.S.L. = Geological Society of London; B.M.N.H., British Museum Natural History; P. T. C., P. T. Cleve's collection, in the Museums of the Universities of Stockholm and Upsala; M.C.Z., Museum of Comparative Zoology; P. A. S., Philadelphia Academy of Sciences; U. S. N. M., United States National Museum; R. T. H., collected by R. T. Hill; J. W. S., collected by J. W. Spencer.



Name or species	Type or orig. spec.	Coll. in U.S.	Remarks.
<i>Plabellum appendiculatum</i> (Prongniart)	P.T.G.		Borrowed Upsala
<i>Plabellum dubium</i> Duncan	G.S.L.		= the later described <u><i>Antillia lonsdaleia</i></u> Duncan
<i>Plabellum exaratum</i> Duncan	G.S.L.		Restudied
<i>Placotrochus sawkinsi</i> Duncan	G.S.L.		Had figured
<i>Placotrochus costatus</i> Duncan	G.S.L.	R.T.H.	Young <u><i>Placocyathus barrettii</i></u> Duncan
<i>Placotrochus lonsdalei</i> Duncan.	G.S.L.		Had type figured
<i>Placotrochus alveolus</i> Duncan.	F.M.N.H.	R.T.H. U.S.N.M.	Belongs to genus <u><i>Placocyathus</i></u> .
<i>Placocyathus barretti</i> Duncan.	F.M.N.H.	R.T.H. U.S.N.M.	Identification O.K.
<i>Placocyathus variabilis</i> Duncan.	G.S.L.	M.C.Z. P.A.S.	Identification O.K.
<i>Placocyathus costatus</i> Duncan.	F.M.N.H.	M.C.Z. P.A.S.	Identification O.K.
<i>Placocyathus moorei</i> Duncan.	G.S.L.	R.T.H., U.S.N.M.	Identification Bilateral form of <u><i>Placocyathus alveo-</i></u> <u><i>lus</i></u> .



<i>Ceratotrochus duodecimcostatus</i> M. Ed. & H.	G.S.L.	
<i>Caryophyllia guadalupensis</i> M. Ed. & H.		
<i>Trochocyathus cornucopiae</i> M. Ed. & H.	B.M.N.H.	
<i>Trochocyathus latero-spinosus</i> M. Ed. & H.	G.S.L.	= <i>Caryophyllia lobatum</i> Vaughan (sp. nov. - type)
<i>Trochocyathus profundus</i> Duncan,	B.M.N.H.	R.T.H., U.S.N.M.
<i>Trochocyathus obesus</i> Mich.,	G.S.L.	= <i>Astrosomilia profunda</i> (Dana) Identification O.K.
<i>Paracyathus kenekeni</i> Duncan.	G.S.L.	<i>Trochocyathus italicus</i> var. <i>Calcar.</i>
<i>Paracyathus crassus</i> M. Ed. & H.	G.S.L.	<i>Rebeschinked</i>
<i>Paracyathus caryophyllus</i> M. Ed. & H.,	G.S.L.	
<i>Paterocyathus guadalupensis</i> Duch. & Mich.		
<i>Trochosmilia laurenti</i> Duch. & Mich.		
<i>Trochosmilia gracilis</i> Duch. & Mich.		
<i>Trochosmilia subcurvata</i> Reuss.	P.T.C.	Specimen borrowed in Upsala



<i>Trochosmilia insignis</i>			<i>Physoeris inequis</i> (Dunc.)
sp. nov.	P.T.C.		
<i>Trochosmilia arguta</i> Reuss	P.T.C.		" " (Borrowed Upsala)
<i>Parasmilia nutans</i>			
Duch. & Mich.			
<i>Asterosmilia abnormalis</i>			
Duncan.	G.S.L.	M.C.Z., P.A.S.	Identification. O.K. Type?
<i>Asterosmilia cornuta</i>			
Duncan.		M.C.Z.	Young slender var. of the preceding. Type?
<i>Asterosmilia exarata</i>			
Duncan.		M.C.Z., P.A.S.	Identification. O.K.
<i>Asterosmilia pourtalesi</i>			
Duncan.	P.T.C.		Type borrowed. Upsala.
<i>Plocophyllia caliculata</i>			
(Catullo)	P.T.C.		
<i>Barysmilia intermedia</i>			
Duncan.	G.S.L.	M.C.Z., P.A.S.	The same species.
<i>Dichocoenia tuberosa</i>			
Duncan.	G.S.L.	U.S.N.M.	Cotypes. U.S. N. M.
<i>Stylophora affinis</i> Duncan			
from S. Domingo	G.S.L.	M.C.Z., P.A.S.	See notes in ms. 2 <sup>nd</sup> cyp. ch of septa sometimes present
<i>Stylophora raristella</i>			
M. Ed. & H.	G.S.L.		See notes in ms.
<i>Stylophora contorta</i>			
(Leymerie)	G.S.L.		" " "



<i>Stylophora minuta</i> Duncan			Type destroyed.
<i>Stylophora mirabilis</i> Duch. & Mich.	G.S.L.		Sue ms.
<i>Stylophora granulata</i> Duncan, from Jamaica	G.S.L.	T.N. Aldrich.	OK.
<i>Stylophora compressa</i> Duncan	P.T.C.		Borrowed upside.
<i>Stylophora distans</i> (Leymerie)	P.T.C.		
<i>Stylophora conferta</i> Reuss.	P.T.C.		
<i>Stylophora tuberosa</i> Reuss.	P.T.C.		
<i>Stylophora granulata</i> Duncan, from St. Barts	P.T.C.		
<i>Stylophora affinis</i> Duncan, from St. Barts.	P.T.C.		
<i>Pocillopora tenuis</i> Duncan			Spec apparently lost.
<i>Pocillopora crassaramosa</i> Duncan.	G.S.L.	M.C.Z. P.A.S.	OK.
<i>Lithophyllia affinis</i> Duncan.	G.S.L.		Type photographed.
<i>Antillia ponderosa</i> (M. Ed. & H.)	R.M.N.H. G.S.L.	R.T.H. U.S.N.M.	<i>Syzygophyllia gregori</i> Varughan. OK.
<i>Antillia dentata</i> Duncan.	G.S.L.	M.C.Z., P.A.S.	OK.



<i>Antillia lonsdaleia</i> Duncan.	G.S.L.	M.C.Z., P.A.S.	O.K.
<i>Antillia bilobata</i> Duncan.	G.S.L.	M.C.Z., P.A.S.	"
<i>Antillia walli</i> Duncan.	G.S.L.	R.T.H., T.H. Aldrich.	"
<i>Circophyllia compressa</i> Duncan.	P.T.C.		Borrowed Upseals
<i>Circophyllia clevei</i> Duncan.	P.T.C.		" "
<i>Heliastraea crasso-</i> <i>lamellata</i> Duncan.	G.S.L.	P.A.S. J.W.S.	Parastrea - O.K.
<i>Heliastraea antiquensis</i> Duncan	G.S.L.		Photo.
<i>Heliastraea endothecata</i> Duncan.	G.S.L.	U.S.N.M.	{ Co-type Washington var. 172, Antigua, <u>O. antiquensis</u> .
<i>Heliastraea tenuis</i> Duncan	G.S.L.	R.T.H.	O.K.
<i>Heliastraea barbadensis</i> Duncan.	G.S.L.	R.T.H. et al.	- <u>O. annularis</u>
<i>Heliastraea costata</i> Duncan.			Photo.
<i>Heliastraea cellulosa</i> Duncan.	G.S.L.	U.S.N.M. J.W.S. &c.	O.K.
<i>Heliastraea megalaxona</i> Duncan.	G.S.L.		See Duncan's fig. 8. Disrupt.



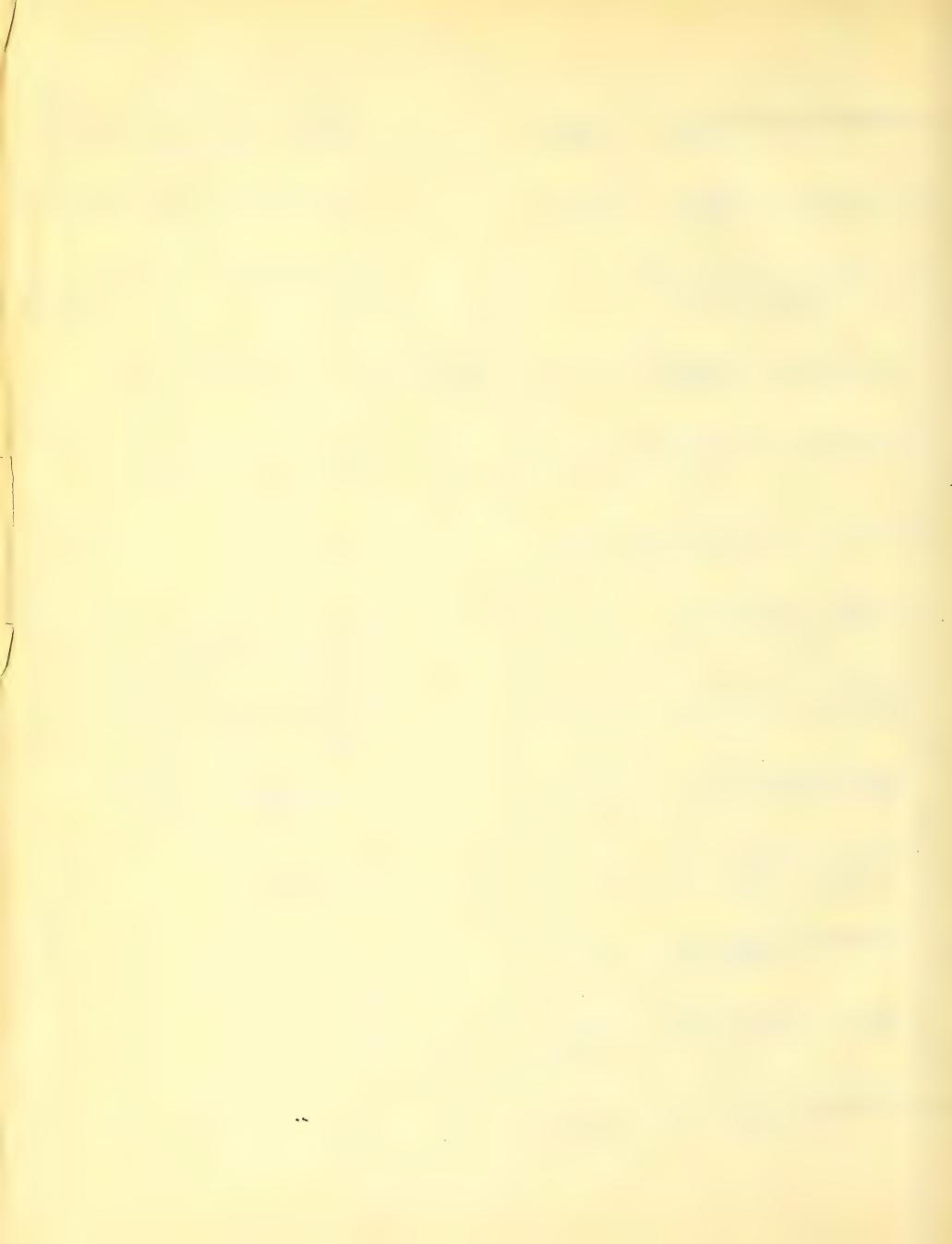
<i>Heliastraea radiata</i> (Ellis & Sol.)	G.S.L.	P.A.S. J.W.S.	Type of var. <i>intromedia</i> Photo
<i>Heliastraea cylindrica</i> Duncan.	G.S.L.	U.S.N.M.	Cotype U.S. N.M.
<i>Heliastraea antillarum</i> Duncan.			Type apparently lost
<i>Heliastraea brevis</i> Duncan	G.S.L.		Photo.
<i>Heliastraea exsculpta</i> (Reuss)	G.S.L.	U.S.N.M. M.C.Z.	The same.
<i>Heliastraea cyathiformis</i> Duncan.	G.S.L.	U.S.N.M. M.C.Z.	Type apparently lost.
<i>Heliastraea altissima</i> Duncan.			
<i>Heliastraea insignis</i> Duncan.			Photo. Type apparently lost.
<i>Heliastraea cavernosa</i> (Esper)	G.S.L.	All W.I. colls.	O.K.
<i>Cyphastraea costata</i> Duncan	G.S.L.	J.W.S.	See previous notes.
<i>Phyllocoenia sculpta</i> M. Ed. & H.	G.S.L.	U.S.N.M.	Cotype U.S. N.M.
<i>Phyllocoenia limbata</i> Duncan.	G.S.L.	M.C.Z. P.A.S.	The same. Cotype U.S. N.M.
<i>Plesiastrea ramea</i> Duncan	G.S.L.	M.C.Z., P.A. S., U.S.N.M.	



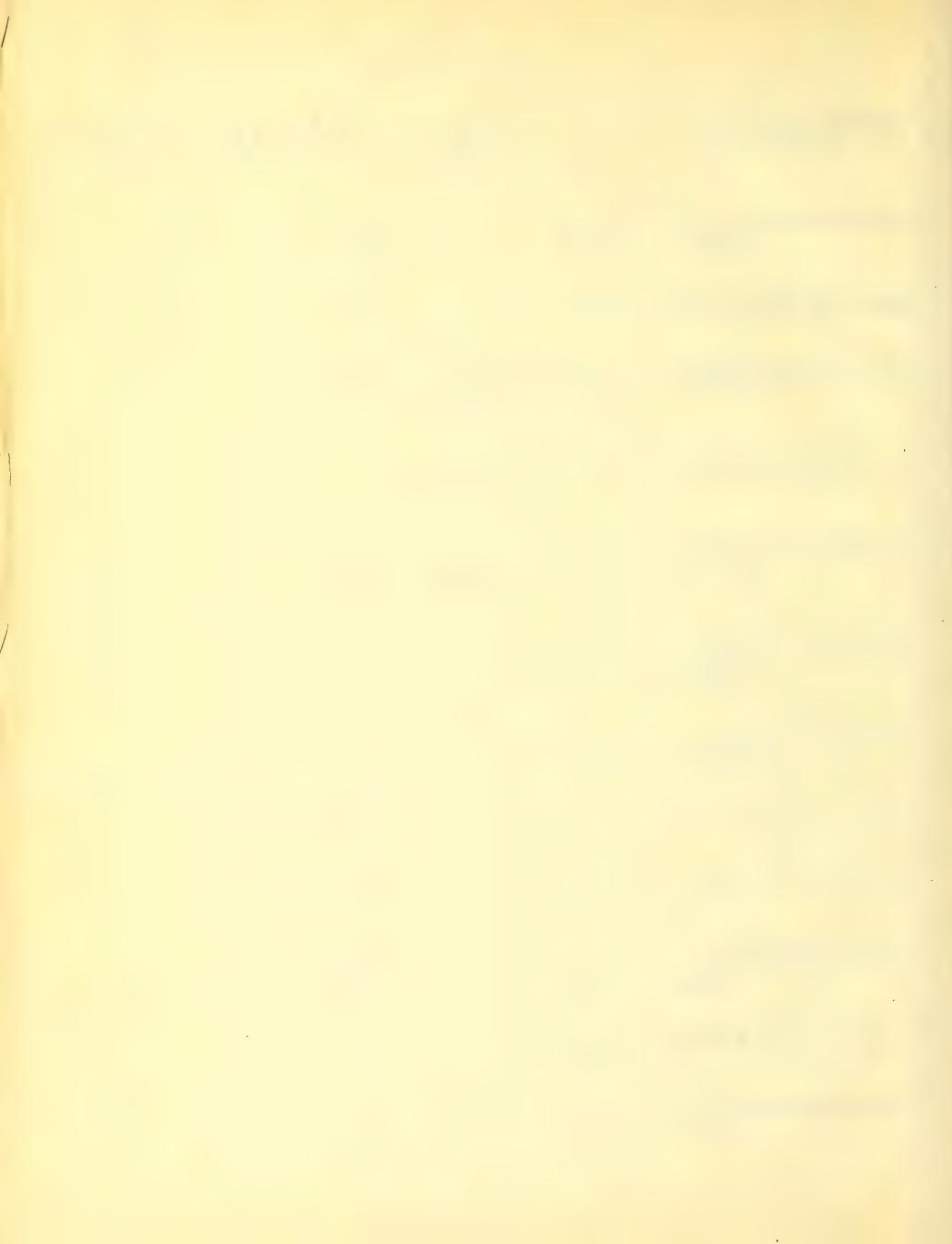
<i>Plesiastreae spongiformis</i>	Duncan.	G.S.L.	All colls.	<i>Stephanocoenia intersepta</i> (Esper).
<i>Plesiastreae distans</i>	Duncan	G.S.L.		
<i>Plesiastreae globosa</i>	Duncan.	G.S.L.	U.S.N.M. } U.S.N.M. }	The same.
<i>Brachiphyllia eckeli</i>	Duncan.			Type apparently lost
<i>Brachiphyllia irregularis</i>	Duncan.			" "
<i>Solenastraea ellisii</i>	Duch. & Mich.	Turin		
<i>Solenastraea verhelsti</i>	M. Ed. & H.	G.S.L.	U.S.N.M.	Specimen - U. S. N. M.
<i>Solenastraea turonensis</i>	Mich.	G.S.L.		undescribable silicified specimen.
<i>Solenastraea columnaris</i>	Reuss.	P.T.C.		(Lipsala)
<i>Diplocoenia monitor</i>	Duncan.			Photo.
<i>Isastraea confusa</i>	Duncan			Type apparently lost.
<i>Isastraea conferta</i>	Duncan	G.S.L.		Photo. ( <i>Siderastraea</i> ).
<i>Isastraea turbinata</i>	Duncan.			Type apparently lost



<i>Stephanocoenia tenuis</i> Duncan	G.S.L.		<i>The same as Duncan's <u>Rho.</u> <u>clavata irregularis</u>? <u>Goniopora</u></i>
<i>Stephanocoenia reussi</i> Duncan.	B.M.N.T.		<i>Redescribed &amp; photographed</i>
<i>Stephanocoenia dendroidea</i> M. Ed. & H.			<i>?</i> <i>Astrocoenia antiquaria</i> Vaughan
<i>Stephanocoenia intersepta</i> (Esper)	G.S.L.	U.S.N.M. M.C.Z. &c.	No. 12477 G.S. O.K.
<i>Stephanocoenia incrustans</i> Duncan.	P.T.C.		<i>Borrowed. Uppsala</i>
<i>Stephanocoenia elegans</i> (Leymerie)	P.T.C.		" "
<i>Stylocoenia lobato-</i> <i>rotundata</i> M. Ed. & H.	G.S.L.		<i>Specimen from Chest of Ata-</i> <i>qua. No. 12458, probably</i> <i>St. pumpellii Vaughan.</i>
<i>Stylocoenia emaciata</i> (Lam.) from St. Barts.	P.T.C.		<i>?</i> <i>S. duerdeni Vaughan</i> (Bor- rowed. Uppsala).
<i>Stylocoenia emaciata</i> (Lam) from Jamaica	G.S.L.		= <i>S. duerdeni Vaughan.</i>
<i>Astrocoenia multi-</i> <i>granosa</i> Reuss.	P.T.C.		<i>Uppsala</i>
<i>Astrocoenia ramosa</i> (Sowerby)	P.T.C.		"
<i>Astrocoenia d'archiardii</i> Duncan.	P.T.C.		"
<i>Astrocoenia ornata</i> M. Ed. & H.	G.S.L.		"



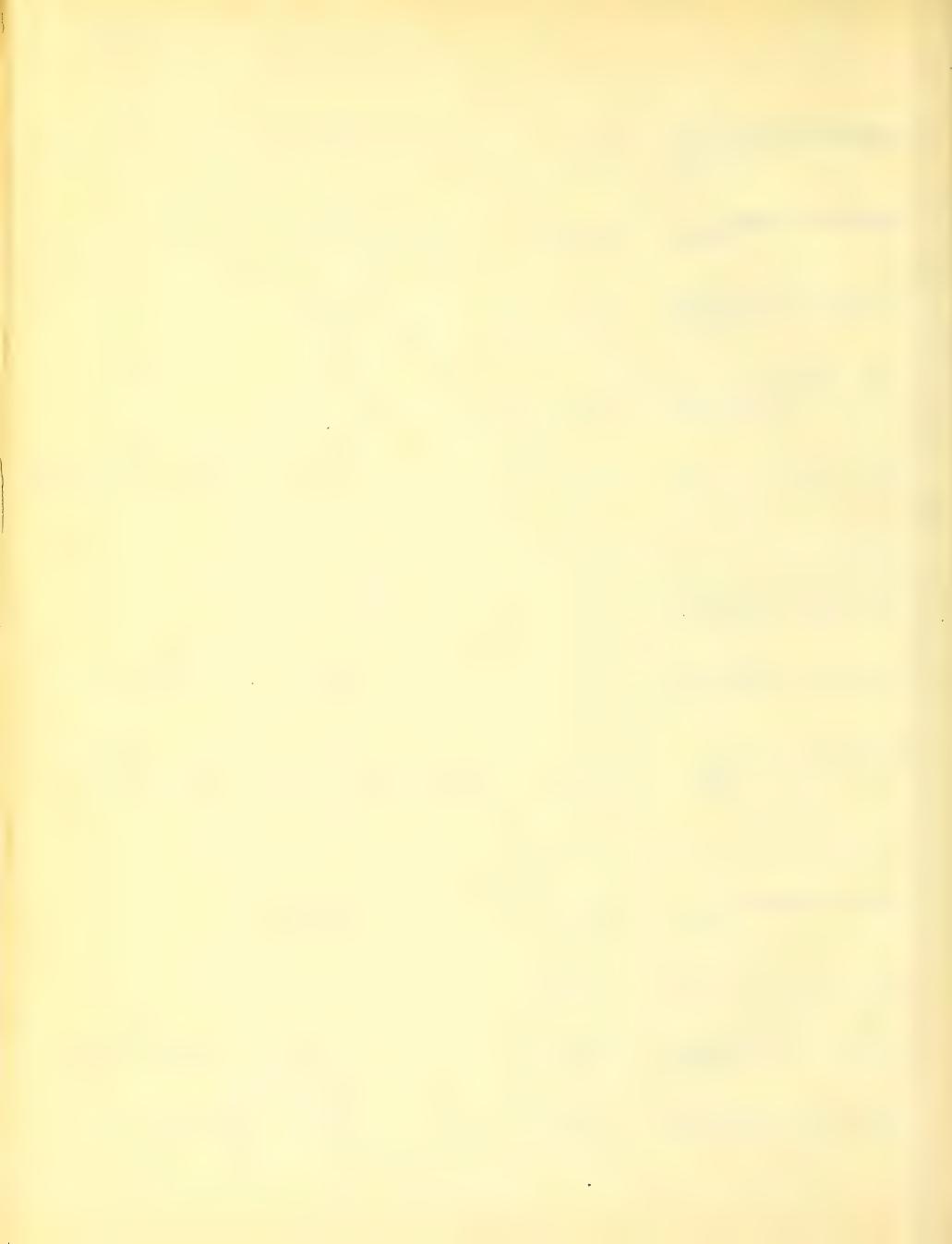
<i>Astrocoenia decaphylla</i> M. Ed. & H.		T. H. Aldrich.	- <i>Madracis bowdenensis</i> Vaughan.
<i>Columnastraea eyeri</i> Duncan	G.S.L.		<i>Sigil</i>
<i>Thysanus corbicula</i> Duncan	G.S.L.		"
<i>Thysanus excentricus</i> Duncan.	B.M.N.H.	R.T.H., U.S.N.M.	<i>OK.</i>
<i>Thysanus elegans</i> Duncan	G.S.L.	R.T.H., U.S.N.M.	"
<i>Teleiophyllia grandis</i> Duncan.	G.S.L.	M.C.Z., P.A.S.	<i>Photo.</i>
<i>Teleiophyllia navicula</i> Duncan.	G.S.L.		"
<i>Lamellastraea smythi</i> Duncan.	B.M.N.H.?		"
<i>Favoidea junghuhni</i> Reuss.			<i>Apparently lost</i>
<i>Goniastraea variabilis</i> Duncan.	P.T.C.		<i>Upsala</i>
<i>Astroria polygonalis</i> Duncan.	G.S.L.		<i>Sigil</i>
<i>Astroria affinis</i> Duncan.	G.S.L.		"
<i>Astroria antigensis</i> Duncan.	G.S.L.		"



<i>Diploria crassolamellosa</i> M. Ed. & H.	G.S.L.	M.C.Z. U.S.N.M.	<i>D. conferti-corbata</i> Vaughan
<i>Macandrina filograna</i> (Esper)	G.S.L.		
<i>Macandrina sinuosissima</i> M. Ed. & H.			
<i>Coeloria labyrinthiformis</i> B.M.N.H. (Ellis)			<i>Jipa</i>
<i>Coeloria dens-elephantis</i> Duncan.	G.S.L.	"	
<i>Leptoria profunda</i> Duncan.	P.T.C.		<i>lipsala</i>
<i>Ulophyllia macrogyra</i> Reuss.	P.T.C.	"	
<i>Manicina areolata</i> (Linn) from S. Domingo	G.S.L.	M.C.Z. &c.	Duncan's identification. O.K.
<i>Manicina areolata</i> (Linn) from St. Barts	P.T.C.		<i>lipsala</i>
<i>Turbinoseris eocaenica</i> Duncan	P.T.C.	"	
<i>Turbinoseris major</i> Duncan.	P.T.C.	"	
<i>Turbinoseris grandis</i> Duncan.	P.T.C.	"	
<i>Turbinoseris angulata</i> Duncan.	P.T.C.	"	

}

<i>Turbinoseris antillarum</i>	Duncan	P.T.C.	<i>Upsala</i>
<i>Turbinoseris clevei</i>	Duncan	P.T.C.	"
<i>Turbinoseris cyclolites</i>	Duncan	P.T.C.	"
<i>Astraea crenulata</i>	Blainville	G.S.L.	
<i>Astraea grandis</i>	Duncan	R.M.N.H.	Reexamined type = <u>S. Siliene</u> .
<i>Astraea pariana</i>	Duncan		
<i>Dimorphastraea guadalupensis</i>	Duch. & Mich.		
<i>Cyathoseris haidingeri</i>	Reuss.	G.S.L.	Redescript. & photo.
<i>Agaricia agaricites</i>	Lam.	G.S.L.	U.S.N.M.&c. } Carts of surface - probably same species.
<i>Agaricia undata</i>	Lam.	G.S.L.	
<i>Astraeopora panicea</i>	Pictet.	P.T.C.	<i>Upsala</i>
<i>Actinacis rollei</i>	Reuss.	P.T.C.	"
<i>Rhodarea irregularis</i>	Duncan	G.S.L.	" <i>Stephanocenia tenuis</i> = <i>Goniopora</i>
<i>Porites reussiana</i>	Duncan	G.S.L.	Photo. <i>Goniopora</i> .



<i>Porites astreoides</i> Lam.		All localities
<i>Porites incrassata</i> Defr.	G.S.L.	The same.
<i>Porites collegiana</i> Mich.	G.S.L.	<i>P. astreoides</i>
<i>Porites ramosa</i> Catullo	P.T.C.	<i>lpsala</i> = <i>Goniopora</i>
<i>Alveopora daedalaea</i> (Forsk) var. <i>minor</i>	G.S.L. G.S.L.	Photo <i>Diam. calus, 1 mm.</i>
<i>Alveopora fenestrata</i> Lam.	G.S.L.	
<i>Alveopora microscopica</i> Duncan.	G.S.L.	



Species listed or described by Duchassaing & Michelotti

which were not found in Turin (in 1897).

*Caryophyllia guadalupensis* M. Ed. & H.

*Paterocyathus guadalupensis* Duch. & Mich.

*Trochosmilia laurenti* Duch. & Mich.

*Trochosmilia gracilis* Duch. & Mich.

*Parasmilia nutans*, Duch. & Mich.

*Dimorphaстраea guadalupensis* Duch. & Mich.

Species the types of which Duncan says are in the Collection  
of the Geological Society of London, but they were not seen  
there (in 1898).

*Asterosmilia cornuta* Duncan.

*Asterosmilia exarata* Duncan.

*Orbicella antillarum* (Duncan). Also E.M.N.H.

*Isastraea turbinata* Duncan.



Species of which the types are said by Duncan to be in the British Museum of Natural History, but were not seen there (in 1898).

*Pocillopora tenuis* Duncan.

*Orbicella antillarum* (Duncan). Also G.S.L.

*Diplotheastraea monitor* Duncan.

*Stephanocoenia reussi* Duncan.

*Astrocoenia decaphylla* M. Ed. & H.

*Favoidea junghuhni* Reuss.

Species of which Duncan does not give the name of the Institute where the types or the specimens studied by him are deposited.

*Orbicella costata* (Duncan). Antigua.

*Orbicella insignis* (Duncan). Antigua.

*Orbicella altissima* (Duncan). Trinidad.

*Brachyphyllia eckeli* Duncan. Trinidad.

*Brachyphyllia irregularis* Duncan. Trinidad.

*Isastraea confusa* Duncan. Trinidad.

*Stephanocoenia dendroidea* M. Ed. & H. Santo Domingo.

"*Maeandrina*" *sinuossima* M. Ed. & H. Santo Domingo. Silts of the Sandstone Plain.

*Coeloria labyrinthiformis* (Ell. & Sol.) Reported from Antigua

*Siderastrea pariana* (Duncan). Trinidad.

*Porites astreoides* Lamarck. Trinidad, Guadalupe, &c.



Cotypes of Duncan's Santo Domingo Corals in the  
U. S. National Museum, received from the Geological Society of  
London.

*Solenastraea verhelstii* Duncan.

*Plesiastraea globosa* Duncan.

*Plesiastraea ramea* Duncan.

*Phyllocoenia sculpta* var. *tegula* Duncan.

*Dichocoenia tuberosa* Duncan.

*Heliastraea endothecata* Duncan.

*Heliastraea cylindrica* Duncan.



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NOTES ON THE FOSSIL CORALS OF THE LESSER ANTILLES  
AND PORTO RICO.

By Thomas Wayland Vaughan.

- - - -

Island of St. Bartholomew, W.I.

For most of our knowledge of the geology of this island we are dependent upon the work of Prof. P. T. Cleve.  
<sup>1/</sup>

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<sup>1/</sup> On the geology of the northeastern West India Islands, Kongl. Svensk. Vetensk. Akad., Handl., Bd. IX, No. 12, p. 24.

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The island of St. Bartholomew is composed of eruptive syenite-porphyry and rocks, partly consisting of igneo-sedimentary breccias and conglomerates, and partly of fossiliferous limestones. The igneo-sedimentary strata of tufas and breccias alternate with beds of the fossiliferous limestone.

<sup>2/</sup>  
Prof. Cleve says:

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<sup>2/</sup> Op. cit., p. 26.

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"The limestone of St. Bartholomew is a very hard and compact rock with a flat, even cleavage. It has a decided tendency to break in parallelopipedic or cubic pieces, separated by fissures generally containing fine crystals of calcareous spar or rock-crystals. That peculiar structure often gives the rock, when viewed from a distance, the appearance of basalt. The limestone sometimes contains numerous fossils, which are generally very badly preserved. Among the fossils are numerous echinoderms, among which is found a species of Macropneustes and Echinolampas ovum serpentis Guppy, also found in the St. Fernando beds of Trinidad. I found, too, a fine specimen of a decapod crustacean of the genus Ranina, of which there is also one species in Trinidad. The foraminifera are very abundant and also many different species of corals. Among the brachiocerous mollusca I found one specimen of Argiope and many specimens of a Terebratula, resembling T. carneae of the cretaceous formation, or the still living T. hyalina. It seems to be the same as T. carneoides Guppy of the St. Fernando beds of Trinidad.



"The gastropodous shells are very numerous and belong to the genera: Voluta, Rostellaria, Natica, Phorus, Cypraea, etc. Among them I found many specimens of a large Nerita closely resembling, if not identical with the N. conoidea Lam. of the Eocene beds around Paris and other places. One large species of the genus Cerithium seems to me to be identical with the C. giganteum Lamk. from the Eocene beds of Paris.

"The bivalves are very numerous. They are represented by large oysters, one Pinna, Spondylus, Plicatula, Inoceramus (?), Lucina, Tellina, Gardita, Cardium, etc.

"The fossil fauna has a decidedly Eocene appearance and may be classed as equivalent to the middle Eocene beds of Europe (Calcaire grossier, Bracklesham beds). The occurrence of fossils of the same species as well in St. Bartholomew as in the San Fernando beds of Trinidad seems to me to prove that the latter also are of Eocene date."

Duncan's "List of fossil corals found in the limestone and conglomerate of St. Bartholomew's, West Indies," compared with the list of species derived from a restudy of his type material, kindly loaned by the University of Upsala, is as follows:

List of fossil corals from  
St. Bartholomew's.

Duncan's names.

Revised names.

<i>Flabellum appendiculatum</i> (Brogn.)	<i>Asterosmilia compressa</i> Vaughan
	{ Pl. xix, fig. 1 = <i>Protethmos bartolomaei</i> Vaughan
<i>Trochosmilia subcurvata</i> Reuss - - -	{ Pl. xix, fig. 1a = <i>Protethmos clevei</i> Vaughan
<i>insignis</i> Duncan }	
<i>arguta</i> Reuss }	- - - <i>Physoseris insignis</i> (Duncan)
<i>Asterosmilia pourtalesi</i> Duncan	<i>Asterosmilia pourtalesi</i> Duncan
<i>Circophyllia compressa</i> Duncan	<i>Antillia ? compressa</i> (Duncan)
<i>clevei</i> Duncan	<i>Antillia ? clevei</i> (Duncan)



Duncan's names.

*Stylophora compressa* Duncan

*distans* (Leym.)

*conferta* Reuss

*tuberosa* Reuss

*granulata* Duncan

*Stylocoenia emarginata* (Lam.)

*Stephanocoenia incrustans* Duncan

*elegans* (Leym.)

*Astrocoenia multigancosa* Reuss

*ramosa* (Sowerby)

*d'achiardii* Duncan

*Ulophyllia macrogyra* Reuss

*Placophyllia caliculata* (Catullo)

*Manicina areolata* (Linn.)

*Leptoria profunda* Duncan

*Goniastrea variabilis* Duncan

*Solenastrea columnaris* Reuss

*Astraeopora panicea* Pictet

*Actinacis rollei* Reuss

*Porites remosa* Catullo

*Turbinoseris eccaenica* Duncan  
    *major* Duncan      }  
    *grandis* Duncan      }

*angulata* Duncan

*antillarum* Duncan

*clevei* Duncan

*cyclolites* Duncan

Revised names.

*Stylephora compressa* Duncan

(

( Could find no specimens with

( labels bearing these names.

(

*Astrocoenia duerdeni* Vaughan

*Astrocoenia incrustans* (Duncan)

Could find no specimen so labeled.

" " " " "

" " " " "

*Astrocoenia d'achiardii* Duncan

*Mesandra duncani* Vaughan

Could find no specimen so labeled.

*Mesandra bartolomaei* Vaughan

*Leptoria profunda* Duncan

*Goniastrea variabilis* Duncan

Could find no specimen so labeled.

*Actinacis bartolomaei* Vaughan

*Goniopora antillarum* Vaughan

*Goniopora bartolomaei* Vaughan

*Antilloseris eccaenica* (Duncan)

*Antilloseris angulata* (Duncan)

*Antilloseris antillarum* (Duncan)

*Placotrochus clevei* (Duncan)

*Antilloseris cyclolites* (Duncan)



The following "species" listed by Duncan are dropped, because the specimens on which he based his determination could not be identified:

*Stylophora distans* (Leym.)

*conferta* Reüss

*tuberosa* Reüss

*granulata* Duncan

*Stephanococenia elegans* (Leym.)

*Astrocoenia multigranosa* Reüss

*ramosa* (Sowerby)

*Plocophyllia caliculata* (Catullo)

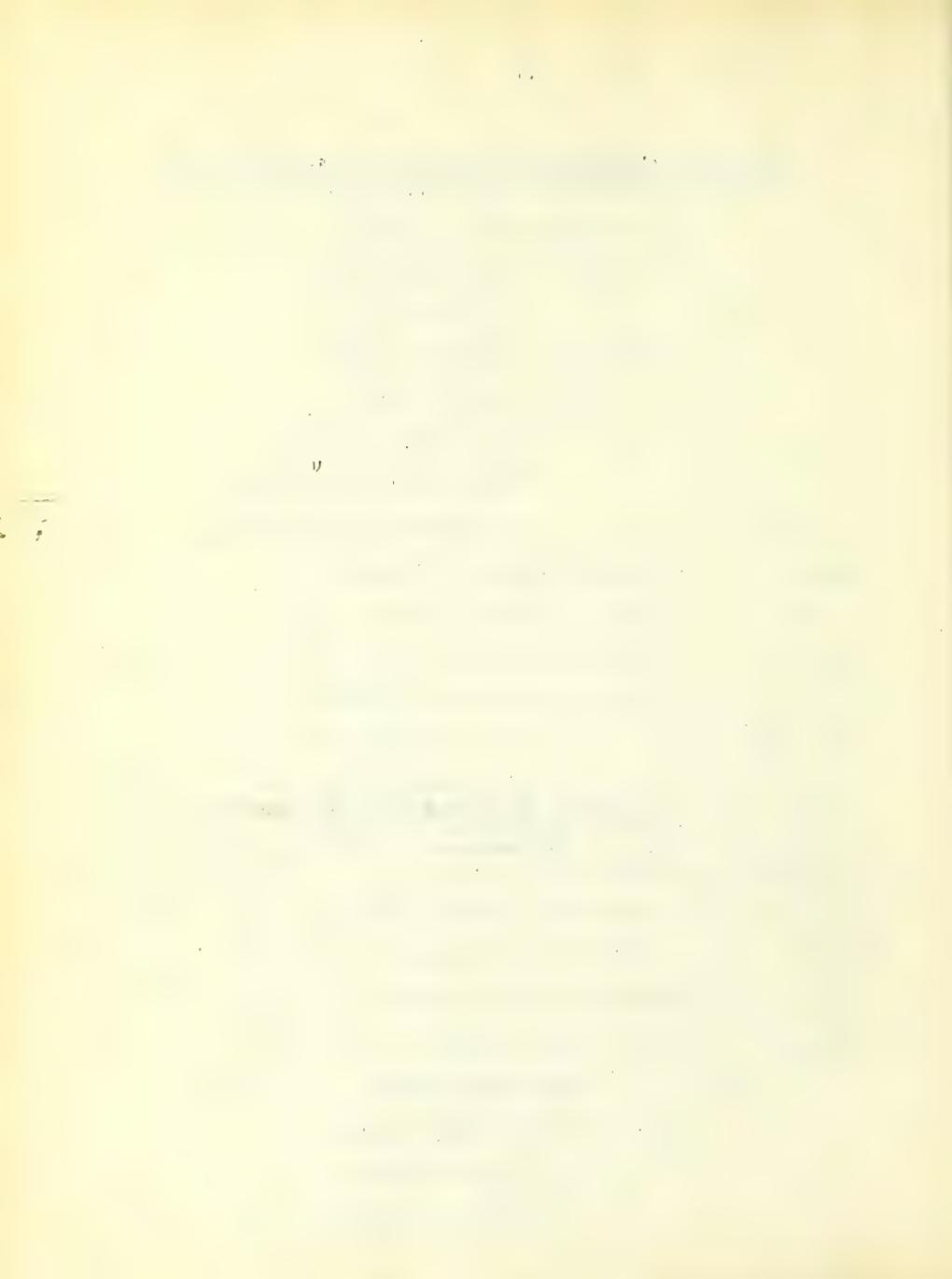
*Solenastrum columnaris* Reüss

With the exception of *Stylophora granulata* Duncan, these are all European species, ranging in age from Cretaceous to Oligocene. In every instance in which the specimens from the West Indies identified by Duncan with European forms were compared with correctly identified material from Europe, Duncan was shown to be wrong -- in fact, the generic determinations are usually erroneous. It therefore seems advisable to expunge these names from the lists of Antillean fossil corals.



List of species of fossil corals from St. Bartholomew  
in the collection of the University of Upsala.

- *Placotrochus clevei* (Duncan)  
- *Asterosmilia compressa* Vaughan  
- *Trochosmilia pourtalesi* Duncan  
- *Trochosmilia hoegbomi* Vaughan  
- *Stylophora compressa* Duncan  
    *forma subnodososa* Vaughan  
    *forma grandinodosa* Vaughan  
    *forma parvinodosa* Vaughan  
- *Antillia ? compressa* (Duncan)  
    *? clevei* (Duncan)  
*Antillia bilobata* Duncan  
*Astrocoenia duerdeni* (Vaughan)  
    *incrustans* (Duncan)  
    *d'achiardi* Duncan  
*Maeandra bartolomaei* Vaughan (2)  
*Syzygophyllia* sp.  
- *Goniastrea variabilis* Duncan  
*Leptoria profunda* Duncan  
*Maeandra duncani* Vaughan (1)  
*Favia clevei* Vaughan  
    *bartolomaei* Vaughan  
- *Antilloseris eocaenica* (Duncan)  
    *angulata* (Duncan)  
    *cyclolites* (Duncan)



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- *Physoseris insignis* (Duncan)
  - *Protethmos bartolomasi* Vaughan
  - clevei* Vaughan
  - molanderi* Vaughan
  - gregorii* Vaughan
  - *Metethmos antillarum* Vaughan
  - *Actinacis bartolomaei* Vaughan
  - *Goniopora bartolomaei* Vaughan ②
  - antillarum* Vaughan ①

Dr. Dall has identified the mollusk, Velates cf. Schmidelianus Chemnitz, which is regarded as Eocene in age.

Dr. Stanton furnishes the following notes on the Cretaceous invertebrates from St. Thomas.

"Mr. T. Wayland Vaughan.

Dear Sir:

"I have examined the small lot of Cretaceous fossils collected by Prof. P. T. Cleve on the island of St. Thomas, West Indies, which you have placed in my hands. While the forms are undoubtedly Cretaceous they do not belong to any American species known to me and I cannot assign them to a definite horizon within the Cretaceous system. If comparisons be made with faunas occurring in the United States the relative abundance of species of Nerinea and the occurrence of Actaeonella suggests the fauna of the Edwards limestone (Lower Cretaceous) more than any other, but this resemblance may be due to similarity of facies rather than of age, for in Europe these genera are common in the Upper Cretaceous, especially the Turoanian. A resemblance to the Cretaceous fauna of Jamaica would naturally be expected but the only suggestion of likeness is in the occurrence of Actaeonella in both, while the Rudistæ which are so conspicuous in Jamaica are not represented here.

"The following genera are recognized in the collections:

- Glycymeris*
- Limopsis*
- Astarte* - several species
- Opis*
- Cyprina* ?
- Corbula*
- Cerithium* - two or more species
- Nerinea* - several species



*Actaeonella*  
*Phylloceras* ? (Immature specimen with septa not  
well shown.)

Yours very truly,  
T. W. Stanton.

Antiguan Fossil Corals.

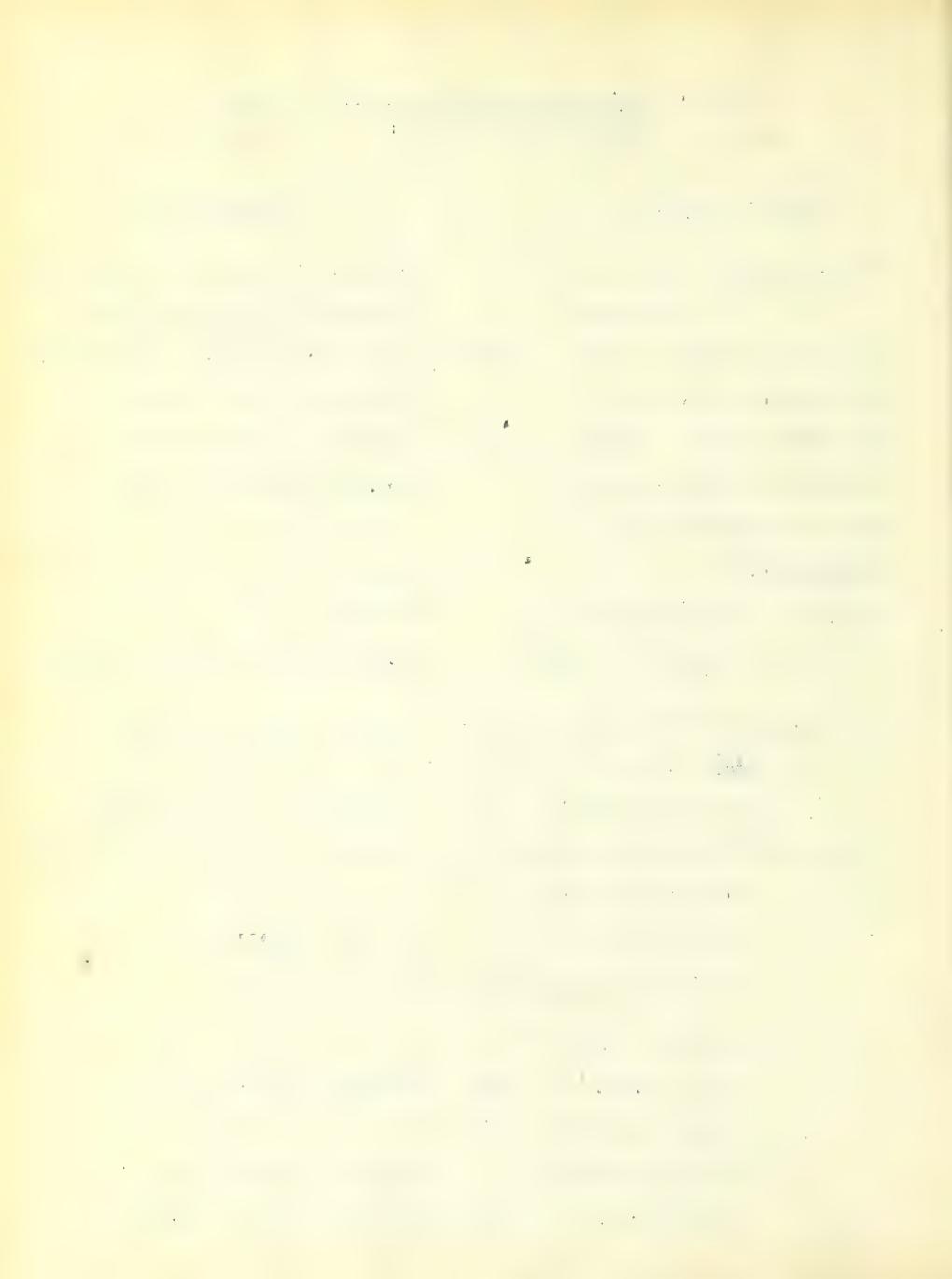
The following lists indicate the fossil corals recorded by Duncan from Antigua, an attempted revision of his names, and the species collected by Mr. Hill. Most of Duncan's types or original specimens are deposited in the Museum of the Geological Society of London, and a few of them in the British Museum of Natural History. I have twice visited the two museums mentioned and through the courtesies of their respective officials have studied all the original material now extant, and have had all of it photographically illustrated. Usually the specimens are poorly preserved and until additional extensive and carefully made collections have been studied, the revision will be unsatisfactory.

The Antiguan coral fauna is of great geological importance as it represents one of the best characterized and most widely recognized geologic horizons in the American Tertiary System. It is known from Porto Rico, Cuba, southern Georgia, Mexico, and Arubo. The coral fauna of the "silex" bed of the Tampa/ is very closely related, as its general aspect is the same and several species are identical. It appears that the Tampa fauna is slightly younger. The abundant coral fauna at Empire, Canal Zone, Panama, is also closely related, but is probably slightly older.



List of corals recorded by Duncan from Antigua  
with their revised names.

<u>Duncan's names.</u>	<u>Revised names.</u>
<i>Stephanocoenia tenuis</i> Duncan <i>reussi</i> Duncan ✓	<i>Goniopora ? tenuis</i> (Duncan) Bernard <i>Stephanocoenia ? reussi</i> Duncan
<i>Astrocoenia ornata</i> Ed. & H. fide Dunc.	<i>Astrocoenia decaturensis</i> Vaughan, ms.
<i>Pocillopora tenuis</i> Duncan ✓	<i>Pocillopora tenuis</i> Duncan
<i>Stylocoenia lobata rotundata</i> Ed. & H.	<i>Stylocoenia pumpellyi</i> Vaughan ?
<i>Lamellastraea smythi</i> Duncan ✓	<i>Lamellastraea smythi</i> Duncan
<i>Favidea junghuni</i> Reuss ✓	
<i>Maeandra</i> sp. ✓	<i>Maeandra</i> sp.
<i>Cocloria labyrinthiformis</i> L. ✓	<i>Maeandra</i> sp.
<i>dens-elephantis</i> Duncan ✓	<i>Maeandra dens elephantis</i> (Duncan)
<i>Astroria antiguensis</i> Duncan ✓ <i>in</i> <i>affinis</i> Duncan ✓ } =	<i>Orbicella tenuis</i> (Duncan)
<i>polygonalis</i> Duncan ✓	<i>Favites polygonalis</i> (Duncan)
<i>Heliastraea crassolamellata</i> Duncan ✓ <i>antiguensis</i> Duncan ✓ } <i>endothecata</i> Duncan ✓ }	<i>Parastrea crassolamellata</i> (Duncan) <i>Orbicella cavernosa</i> (Linn.)
<i>radiata</i> var. <i>intermedia</i> ✓ Duncan }	
<i>antillarum</i> Duncan ✓ }	
<i>costata</i> Duncan ✓ }	<i>Orbicella cavernosa</i> (Linn.)
<i>insignis</i> Duncan ✓ }	
<i>barbadensis</i> Duncan ✓	<i>Orbicella annularis</i> Dana ?
<i>tenuis</i> Duncan ✓	<i>Orbicella tenuis</i> (Duncan)



Duncan's names.

- Heliastraea cellulosa* Duncan ✓  
    *megalaxona* Duncan ?  
*Astraea grandis* Duncan ?  
*Iseastraea conferta* Duncan ✓  
    *turbinata* Duncan -  
    *confusa* Duncan 2/  
*Solenastraea turonensis* Michelin  
*Diplotheccastraea monitor* Duncan ✓  
*Rhodaraea irregularis* Duncan  
*Alveopora daedalea* var. *regularis* ?  
    (Duncan)  
*Alveopora microscopica* Duncan ✓

Revised names.

- Orbicella cellulosa* (Duncan)  
? *megalaxona* (Duncan)  
*Siderastrea* sp. (not *S. grandis*)  
    Duncan)  
*Siderastrea conferta* (Duncan)  
  
*Diplotheccastraea monitor* Duncan  
*Goniopora* ? *tenuis* (Duncan)  
*Alveopora regularis* Duncan  
*Alveopora* ? *microscopica* Duncan

1/ Type or original specimen lost.

2/ Unidentifiable.

The following would be the revised list of the species of corals reported by Duncan from Antigua:

Revised list of fossil corals reported by Duncan from Antigua.

- Stylococenia pumpellyi* Vaughan  
*Stephanocoenia* ? *reussi* Duncan  
    *portoricensis* Vaughan (flat-br.)  
*Astrocoenia decaturensis* Vaughan (massive)  
    *antiquensis* Vaughan (elliptical br.)  
*Pocillopora tenuis* Duncan  
*Favites polygonalis* (Duncan)  
*Lamellastraea smythi* Duncan  
*Maeandra dens-elephantis* (Duncan)  
*Orbicella tenuis* (Duncan)  
    *cellulosa* (Duncan)  
    *cavernosa* (Linn.)



- . *Orbicella* ? *megalaxona* (Duncan)
- . *Diplotheocostraea* monitor Duncan
- . *Siderastrea conferta* (Duncan)
- . *Parastrea crassolamellata* (Duncan)
- . *Goniopora* ? *tenuis* (Duncan)
- . *Alveopora regularis* Duncan
- ? *microscopica* Duncan

List of fossils collected by Mr. R. T. Hill  
in Antigua.

No 106. Golf Link Hill, Antigua.

- Astrocoenia antiquensis* Vaughan, ms.
- Orbicella cavernosa* (Linn.)
- tenuis* (Duncan)
- cellulosa* (Duncan)
- Parastraea crassolamellata* (Duncan)
- Goniopora* sp. 1
- sp. 2

No. 120. Two miles southeast of St. Johns, old reef rock.

- Orbicella cavernosa* (Linn.)

*Morris Looky*  
No. 171. *Morrislowey* Hill.

- Stylecoenia antiquensis* Vaughan, ms.
- Astrocoenia decaturnesis* Vaughan, ms.
- Astreopora antiquensis* Vaughan, ms.



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No. 174. Blake Estate.

*Orbicella tenuis* (Duncan)

No. 177. Rifle Buttes at contact of limestone.

*Stylephora antiquensis* Vaughan, ms.

*Eusmilia* sp.

*Astrocoenia antiquensis* Vaughan, ms.

*Orbicella cellulosa* (Duncan)

*Gonicopora* sp.



Island of Anguilla.

1/  
According to Prof. Cleve, the lowest geological formation exposed on the island of Anguilla consists of dark, amygdaloidal trappean rock,

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1/ On the geology of the northeastern West India Islands, Kongl. Svenska. Vetensk. Akad., Handl., Bd. IX, No. 12, p. 22, 1871.

---

which is covered by a yellowish soft limestone bed containing many fossil corals and echinoderms. He says:

"The fossils of the marls and limestones of Anguilla are generally badly preserved, most of them being only casts, which makes their determination very difficult."

The collection of fossil corals made by Prof. Cleve was kindly lent me by the University of Upsala. The matrix of the specimens is a yellow calcareous clay and from Prof. Cleve's description I suppose that they were obtained from the soft yellowish limestone bed which immediately overlies the amygdaloidal igneous rock.

List of fossil corals from the Upper  
Oligocene of Anguilla.

Several casts that resemble Antillia bilobata Duncan

Antillia anguillensis Vaughan

Cladodora anguillensis Vaughan

Orbicella cavernosa (Linn.) Georgia, etc.

Orbicella cavernosa var. anguillensis Vaughan

Mussa (Syphylia) anguillensis Vaughan

Agaricia anguillensis Vaughan

Goniopora clevei Vaughan

Goniopora tampaensis Vaughan Tampa, Fla.



· *Porites anguillensis* Vaughan

· *Porites* sp. Anguilla

· *Stylophora alumensis* Vaughan ? Alum Bluff, Fla.

· *Stylophora anguillensis* Vaughan

Porto Rico.

The following account of the geologic succession in Porto Rico  
*l/*  
is compiled from the publications of R. T. Hill.

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*l/* Notes on the forest conditions of Porto Rico; U. S. Dept. Agriculture,  
Div. of Forestry Bull. No. 25, pp. 14, 15, 1899.

---

The geology and physical geography of Jamaica: Bull. Mus. Comp. Zool.,  
vol. xxxiv, Appendix I, p. 225, 1899.

---

The description of the section in ascending order is as follows:

(1) An older plexus of water-sorted hornblendic volcanic material,-  
*l.*  
tuffs and conglomerates with interbedded Cretaceous Rudistean limestone  
similar to that of Jamaica, composing the central mountains.

There are two limestone formations, both of small area, interbedded  
in the mass of volcanic rock. One of these, found on the crest of the  
island near Cayey and Aibonito, is a black, bituminous, shaly limestone  
interbedded with volcanic conglomerate. This calcareous horizon, fully  
1,000 feet thick, apparently forms the crest of the sierra and weathers  
into soils noted as the best tobacco lands on the island. The other is  
a light gray crystalline limestone with Cretaceous fossils (Rudistes).  
It outcrops on an east and west line from near Cabo Rojo to 15 kilo-  
meters north of Ponce on the Adjuntas road.



(2) An Eocene system composed of a great thickness of impure lignitic sands and clays like the Richmond beds (of Jamaica), and which outcrops near San Sebastian, Guatemala, and Mocha, on the western end of the island, and near Carolina on the northeast coast.

(3) Fossiliferous greensand marls of undetermined age (Eocene or Oligocene), at least 100 feet thick.

(4) Hard, calcareous marl, full of coral heads, with occasional indurated strata of white porous limestone of upper Oligocene age. These rocks are described as the Pepino formation and are exposed in the Pepino Hills north and northwest of Lares,

(5) White, loose-textured limestones composing the hills of the south coast, probably of Pleistocene age, although some of the lower strata may be as old as Oligocene.

(6) Elevated reefs - these are poorly developed in Porto Rico.

(7) Alluvial plains of Pleistocene age.

The fossil corals obtained by Mr. Hill occur in the Pepino formation, 4 miles west of Lares. They are of upper Oligocene age and are similar to the fauna of the Island of Antigua.

List of fossil corals from Porto Rico.

- ' Astrocoenia portoricensis Vaughan (also Antigua)
- . Orbicella cav ernosa var. antiguensis (Duncan) (also Antigua)
- . Orbicella cavernosa Lin (also Antigua)
- . Orbicella tenuis (Duncan) (also Antigua)
- ✓ Masandra ? portoricensis Vaughan
- Siderastrea portoricensis Vaughan = ? S. conferta (Duncan)  
(from Antigua)
- Agaricia portoricensis Vaughan
- Astreopora portoricensis Vaughan
- Goniopora portoricensis Vaughan



List of Pleistocene and Recent corals collected in the  
West Indies by Mr. Robert T. Hill.

Mostly from Jamaica.

6. *Siderastrea siderea* (Ell. & Sol.)

*Acropora palmata* (Lam.)

*Porites astreoides* Lam. (probably *porites* (Pallas) )

7. (Probably Barbados)

*Siderastrea radians* (Pallas)

*siderea* (Ell. & Sol.)

7. Barbicon Bluff, Jamaica.

*Porites porites* (Pallas)

9. Barbados.

*Orbicella annularis* (Ell. & Sol.)

9. 17-9/10 contact.

*Maeandra labyrinthiformis* (Linn.)

*Siderastrea siderea* (Ell. & Sol.)

*Acropora* sp.

12. Barbados.

*Maeandra labyrinthiformis* (Linn.)

*Manicina gyrosa* (Ell. & Sol.)

26. Manchioneal Bluff, Jamaica.

*Manicina gyrosa* (Ell. & Sol.)

*Agaricia*



30. Old Soberrucco, mouth of Priestmans River, Jamaica.

*Siderastrea radians* (Pallas)

38. *Acropora palmata* (Lam.)

39. *Stephanocoenia intersepta* (Esper)

*Orbicella annularis* (Ell. & Sol.)

*Maeandra strigosa* (Dana)

*clivosa* (Ell. & Sol.)

*Siderastrea radians* (Pallas)

*Acropora muricata* (Linn.)

*Porites porites* (Pallas)

*furcata* Lam.

50. Orange Bay, Jamaica.

*Acropora palmata* (Lam.)

54. Runaway Bay, Jamaica.

*Acropora palmata* (Lam.)

71. Near St. Ann's Bay, Jamaica.

*Siderastrea siderea* (Ell. & Sol.)

*Porites porites* (Pallas)

77. Top of Baker Hill, Bowden ? Jamaica.

*Stylephora* sp.

*Placocyathus* ? sp.



## 93. Mulatto River, Jamaica.

- Orbicella annularis* (Ell. & Sol.)  
*cavernosa* (Linn.)  
*Maeandra strigosa* (Dana)

## Montego Bay, Jamaica.

- Maeandra areolata* (Linn.)  
*Agaricia agaricites* (Linn.) var.

## 96. Baynes Atoll, Montego Bay, Jamaica (Recent)

- Acropora palmata* (Lam.)

Barbados.

## 121. Edge Bathsheba summit, Barbados (in situ).

- Agaricia agaricites* (Linn.)

## 17. Rolled material from erratics of Edge Cliff, Bathsheba.

- Orbicella annularis* (Ell. & Sol.)

~~xxxxxx~~ (Linn.)

## 123. Debris at foot of Edge Cliff, Barbados.

- Orbicella annularis* (Ell. & Sol.)  
*Manicina gyrosa* (Ell. & Sol.)  
*Maeandra clivosa* (Ell. & Sol.)  
*Maeandra labyrinthiformis* (Linn.)



124. Road metal made from debris of Edge Cliff, Barbados.

*Orbicella annularis* (Ell. & Sol.)

*cavernosa* (Linn.)

125. Locust Hall, Barbados.

*Orbicella annularis*

126. Welch's quarry, Bridgetown, Barbados.

*Orbicella annularis* (Ell. & Sol.)

*Manicina gyrosea* (Ell. & Sol.)

*Acropora muricata* (Linn.) (= *cervicornis* (Lam.))

*Porites astreoides* Lam.

127. Rolled boulder from Hochlerster's cliff, just above Beach Mount Hotel.

*Orbicella annularis* (Ell. & Sol.)

*Agaricia*, impression of surface, probably  
*A. agaricites* (Linn.)

128. No. 5 Barbados No.

*Orbicella annularis* (Ell. & Sol.) (costae often incomplete)

131. No. 3 Barbados No.

*Orbicella annularis* (Ell. & Sol.)

132. Dayrell, Barbados.

*Orbicella annularis* (Ell. & Sol.)

*Agaricia agaricites* (Linn.)

*Lithothamnion* sp.



133. Living coral from beach, Bathsheba, Barbados.

*Porites furcata* Lam.

134. Reef back of W. I. camp kitchen, Bridgetown.

*Eusmilia aspera* (Dana)

*Astrangia* sp.

*Orbicella annularis* (Ell. & Sol.)

*Siderastrea siderea* (Ell. & Sol.)

*Agaricia agaricites* (Linn.)

*Acropora muricata* (Linn.)

137. Horse Hill, Barbados.

*Dichocoenia stokesi* M. Edw. & H. (?)

*Orbicella annularis* (Ell. & Sol.)

139. Governors terrace, Barbados.

*Eusmilia aspera* (Dana)

*Stephanocoenia intersepta* (Esper)

*Orbicella annularis* (Ell. & Sol.)

*cavernosa* (Linn.)

*Manicina gyroza* (Ell. & Sol.)

*Mussa dipsacea* Dana

*Agaricia agaricites* (Linn.) var. *purpurea* Les.

*Acropora muricata* (Linn.)

*Porites furcata* Lam.



140. Barbados, No. 2 reef, lime-kiln quarry.

*Stephanocoenia intersepta* (Esper)

142. Roadside, reef No. 1, Barbados.

*Orbicella annularis* (Ell. & Sol.)

*Maeandrina labyrinthiformis* (Linn.)

*Acropora muricata* (Linn.)

143. Waterford Hill (Nullipora) reef, Barbados.

*Acropora* sp. fragment

Massive *Lithothamnion*

147. St. Helen's terrace, Barbados.

*Madracis decactis* (Lyman)

*Porites*, probably *furcata* Lamk.

*Manicina gyroea* (Ell. & Sol.)

*Agaricia nobilis* Verrill ?

150. Vancluse terrace, Barbados.

*Orbicella annularis* (Ell. & Sol.)

annularis var. small calices, costae  
frequently incomplete.

151. Beach sands, Hastings, Barbados.

*Porites furcata* Lam.

156. Barbados, reef No. 2 (collection of Feb. 24, 1897).

*Acropora muricata* (Linn.)

157.

*Orbicella annularis* (Ell. & Sol.)



158. "Candle" bed reef, S. 100, New Street, Martins, Barbados.

*Siderastrea siderea* (Ell. & Sol.)

*Acropora muricata* (Linn.)

159. Near St. Martins Bay, Barbados, supposed 160-foot reef.

*Orbicella annularis* (Ell. & Sol.)

Kingsbury collection, Barbados.

*Eusmilia aspera* (Bana)

*Manicina gyrosa* (Ell. & Sol.)

*Maeandra labyrinthiformis* (Linn.)

*Acropora muricata* (Linn.)

*palmata* (Lam.)

*Porites* sp. (probably *porites* (Pallas) )

*astrecides* Lam.

Barbuda.

192. Barbuda.

*Acropora palmata* (Lam.)

194. Barbuda.

*Orbicella annularis* (Ell. & Sol.)

*Acropora palmata* (Lam.)

196. Barbuda.

*Acropora muricata* (Linn.)



Fossil Corals collected by Dr. Ernest Howe in the West Indies.

Description of localities whence corals were collected.

Specimens Gda. 2, 3, 4, 5.

Raised coral reef, Laurant Point, west of Sautours, St. Patrick's Parish, Granada.

At 250 feet above sea level, where the road crosses the end of Laurant Point, there are exposures of a raised coral reef. It rests upon a fine-grained, decomposed rock, probably tuff. With the exception of veins and seams of calcareous material, the first true limestone is a hard, massive rock composed of corals in place and growing on a rock composed of tuff in large and small fragments and minute shells. This bed varies from 1 to 18 inches in thickness. (Specimens numbered Gda. 2 from this horizon.)

Gda. 2. *Stephanocoenia intersepta* (Esper)

*Porites* sp.

Above this horizon, and of unknown thickness (about 5 or 6 feet from base to present upper surface) is a marly limestone filled with stag-horn corals (Gda. 3) much broken and wave-worn. This bed contains much volcanic material scattered through it in the form of fine sand, hornblende being prominent.

Gda. 3. *Acropora muricata* (Linn.) ?

One hundred feet below this locality the same beds outcrop and the same general section of the limestone occurs (Gda. 4 and 5) with more marly limestone above. Under the limestones are 4 feet of thin bedded, fine-grained tuffs, and under these a massive, decomposed rock. At this



locality the limestones dip  $54^{\circ}$  N.  $10^{\circ}$  E.; at the first locality, on the road,  $30^{\circ}$ , strike N.  $45^{\circ}$  E.

Gda. 4 Not identifiable.

Gda. 5. *Stephanocoenia intersepta* (Esper)

*Dichocoenia stokesii* M. Edw. & H.

Dominica, raised coral reef, above road, 2 miles north of Roseau.

This raised reef rests on a loamy conglomerate of large water-worn boulders which in turn rest on well-bedded tuffs. The elevation of the base varies from 50 to 75 feet above the sea and the reef is about 30 feet thick, covered by a thin layer of soil. It seems clearly a raised reef with the corals in situ. (Specimens lettered - Dom.)

*Madracis* sp. (recent off Port Castries, Santa Lucia)

*Stephanocoenia intersepta* (Esper)

*Macandrina macandrites* (Linn.)

*Orbicella cavernosa* (Linn.)

*Siderastrea siderea* (Ell. & Sol.)

Brimstone Hill, St. Kitts. (Specimen SK 2)

The limestone from which this specimen was collected is a white, rather soft marl, containing much reef-building coral (SK 2) in a shattered or brecciated condition, and not in a growing position. The hill is about 800 feet high and the limestone extends fully half of the way up in the northern, western, and southern sides; none occurs on the east-

*Siderastrea siderea* (Ell. & Sol.)



List of Species Described in this Manuscript.

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Name of species	Locality	Page
<i>Placotrochus clevei</i> (Duncan)	St. Bartholomew	
<i>Asterosmilia compressa</i> Vaughan	St. Domingo; St. Bartholomew	
<i>Asterosmilia pourtalesi</i> Duncan	St. Bartholomew	
<i>Trochosmilia hoegbomi</i> Vaughan spenceri Vaughan	St. Bartholomew Yellow marl, Antigua	
<i>Parasmilia antiquensis</i> Vaughan	Yellow marl, Antigua	
<i>Stylephora affinis</i> Duncan minor Duncan	Nivaje shale, Sto. Domingo Nivaje shale, Sto. Domingo	
<i>menticulosa</i> Vaughan	St. Domingo	
<i>Stylephora</i> <del>antiquensis</del> Vaughan	Antigua; Barbados ?	
<i>compressa</i> Duncan	) Limstone	
<i>forma subnodosa</i> Vaughan	) of St.	
<i>forma grandinodosa</i> Vaughan	)	
<i>forma parvinodosa</i> Vaughan	) Bartholomew	
<i>anguillensis</i> Vaughan	Anguilla	
<i>alumensis</i> Vaughan	Chipola marl; Anguilla	
<i>minutissima</i> Vaughan	Bainbridge, Ga.	
<i>silicensis</i> Vaughan	Tampa; Bainbridge	
<i>granulata</i> Duncan	Bowden, Jamaica	
<i>decaturensis</i> Vaughan	Bainbridge, Ga.	
<i>mammillata</i> Vaughan	Bainbridge, Ga.	
<i>minuta</i> Duncan	St. Croix, Trinidad	
<i>ponderosa</i> Vaughan	Salt Mt., Ala.	



		Page
Madracis dominicensis Vaughan	Santo Domingo	
Pocillopora crassoramosa Duncan	Nivaji shale, Sto. Domingo	
tenuis Duncan	Antigua	
Stephancoenia reussi Duncan	Antigua	
Stylocoenia pumpellyi (Vaughan)	Bainbridge; Antigua, etc.	
Astrocoenia decaturensis Vaughan	Bainbridge; Antigua, etc.	
portoricensis Vaughan	Porto Rico; Antigua	A. H. D. G. E. H. December
antiguensis Vaughan	Antigua; Barbados ?	
d'achiardii Duncan	St. Bartholomew	
duerdeni Vaughan	Jamaica; St. Bartholomew	
incrustans (Duncan)	St. Bartholomew	
Antillia ? compressa (Duncan)	St. Bartholomew	
? clevei (Duncan)	St. Bartholomew	
bicolorata Duncan	St. Bartholomew	
anguillensis Vaughan	Anguilla	
Cladocora anguillensis Vaughan	Anguilla	
Orbicella annularis (Ell. & Sol.)	Pleistocene; Oligocene of Antigua ?	
limbata (Duncan)	Santo Domingo	
altissima (Duncan)	St. Croix, Trinidad	
cellulosa (Duncan)	Antigua; Florida; Georgia	
var. silicensis Vaughan	Bainbridge; Tampa	
var. curvata (Duncan)	Antigua (chert)	
Orbicella ? megalaxona (Duncan)	Antigua (chert)	
tenuis (Duncan)	Marl, Antigua; Porto Rico; Aruba	195
cavernosa (Linn.)	Pleistocene; Oligocene	—
var. tampaensis Vaughan	Tampa; Porto Rico	
var. silicensis Vaughan	Tampa	
var. bainbridgensis Vaughan	Bainbridge	
var. anguillensis Vaughan	Anguilla	



	<u>Page</u>
<i>Orbicella antillarum</i> (Duncan)	Montserrat
<i>insignis</i> (Duncan)	Antigua
<i>costata</i> (Duncan)	Marl, Antigua
<i>gabbi</i> Vaughan	Sto. Domingo
<i>spenceri</i> Vaughan	Antigua
<i>Brachyphyllia eckeli</i> Duncan	St. Croix, Trinidad
<i>irregularis</i> Duncan	St. Croix, Trinidad
<i>Cyphastrea hyades</i> (Dana)	Pliocene, Florida
<i>caribaea</i> Duchass. & Micht.	Pliocene, Florida, etc.
<i>Solanestrea turonensis</i> (Michelin) Duncan	Antigua     "
<i>verhelsti</i> M. Edw. & H. Duncan	Santo Domingo
<i>columnaris</i> Reuss. Duncan	St. Bartholomew
<i>Diplothescaстраea monitor</i> (Duncan)	Antigua (chert)
<i>Favites polygonalis</i> (Duncan)	Antigua (chert)
<i>Favia clevei</i> Vaughan	St. Bartholomew
<i>bartolomaei</i> Vaughan	St. Bartholomew
<i>Lamellastraße smythi</i> Duncan	Antigua
<i>Goniastrea variabilis</i> Duncan	St. Bartholomew
<i>Favoidea junghuhni</i> Reuss. Duncan	Antigua ?
<i>Liptoria profunda</i> Duncan	St. Bartholomew
<i>Maeandra bartolomaei</i> Vaughan	St. Bartholomew
<i>duncani</i> Vaughan	St. Bartholomew
<i>portoricensis</i> Vaughan	Porto Rico
<i>dens-elephantis</i> Duncan	Antigua (chert)
<i>Syzygophyllia</i> sp.	St. Bartholomew
<i>Sympyllia anguillensis</i> Vaughan	Anguilla

Prb lceL12

<i>Sympyllia</i>	Antigua
<i>Siderastrea portoricensis</i> Vaughan	Porto Rico
<i>conferta</i> (Duncan)	Antigua
" <i>Isastrea</i> " <i>turbinata</i> Duncan	Antigua (chert)
<i>confusa</i> (Duncan)	St. Croix, Trinidad
<i>Agaricia portoricensis</i> Vaughan	Porto Rico
<i>anguillensis</i> Vaughan	Anguilla
<i>Oroseris antiguensis</i> Vaughan	Antigua
<i>Antilloseris eocaenica</i> (Duncan)	St. Bartholomew
<i>angulata</i> (Duncan)	St. Bartholomew
<i>cyclolites</i> (Duncan)	St. Bartholomew
<i>Physoseris insignis</i> (Duncan)	St. Bartholomew
<i>Protethmos bartolomaei</i> Vaughan	St. Bartholomew
<i>clevei</i> Vaughan	St. Bartholomew
<i>molanderi</i> Vaughan	St. Bartholomew
<i>gregorii</i> Vaughan	St. Bartholomew
<i>Melethmos antillarum</i> Vaughan	St. Bartholomew
<i>Parastrea crassolamellata</i> (Duncan)	Antigua; Cuba, etc.
var. <i>magnetica</i> (Duncan)	Marl, Antigua
var. <i>pulchella</i> (Duncan)	Marl, Antigua
var. <i>nobilis</i> (Duncan)	— —
var. <i>minor</i> (Duncan)	Marl, Antigua
var. <i>nugenti</i> (Duncan)	Chert or marl, Antigua
var. <i>magnifica</i> (Duncan)	Marl, Antigua
<i>hilli</i> Vaughan	Clay marl, Antigua
<i>Actinacis bartolomaei</i> Vaughan	St. Bartholomew
<i>decaturensis</i> Vaughan	Bainbridge, Ga.



<i>Astreopora antiquensis</i> Vaughan	Bainbridge, Ga.; Antigua
<i>portoricensis</i> Vaughan	Lares, Porto Rico + 30
<i>Goniopora reussiana</i> (Duncan)	Jamaica
<i>bartolomaei</i> Vaughan	St. Bartholomew
<i>antillarum</i> Vaughan	St. Bartholomew
? <i>tenuis</i> (Duncan)	Marl, Antigua
<i>bowdenensis</i> Vaughan	Jamaica
<i>tampaensis</i> Vaughan	Anguilla; Tampa, Fla.
<i>calhounensis</i> Vaughan	Chipola, White Springs, Fla.
<i>decaturensis</i> Vaughan	Bainbridge, Ga.
var. <i>silicensis</i> Vaughan	Bainbridge, Ga.
var. <i>caeruleifontis</i> Vaughan	Bainbridge, Ga.
var. <i>bainbridgensis</i> Vaughan	Bainbridge, Ga.
<i>clevei</i> Vaughan	Anguilla
<i>portoricensis</i> Vaughan	Lares, Porto Rico + 30
<i>Porites anguillensis</i> Vaughan	Anguilla
sp.	Anguilla
<i>Alveopora regularis</i> Duncan	Chert and marl, Antigua
<i>minor</i> Duncan	Chert, Antigua
<i>microscopica</i> Duncan	Marl, Antigua
<i>fenestrata</i> Dana, Duncan	Marl, Antigua
<i>tampae</i> Vaughan	Tampa, Fla.



Placotrochus clevei (Duncan).

1873. Turbinoseris clevei, Duncan, Quart. Jour. Geol. Soc. London, Vol. XXIX, p. 560, Pl. XXII, figs. 17, 17a, 17b.
1899. Turbinoseris clevei, Vaughan, Bull. Mus. Comp. Zool., Vol. XXXIV, p. 230.

Original description:

"The corallum is turbinate and compressed. It has a broad peduncle, with the mark of a former attachment.

"The calice (section) is elliptical.

"The septa are numerous, very irregular in their course, thin, and unequal.

"The costae are prominent, unequal, and distant, the wall being visible between them.

"The synapticulae are large between the septa, but do not exist between the costae. The wall is thick. There is no epitheca.



"Height of corallum 33 mm. Length of calice 33 mm.breadth  
15 mm."

"Loc.---Limestone of St. Bartholomew's, West Indies."

Type: University of Upsala, Sweden.

Remarks: This species does not belong in the same genus with Duncan's Turbinoseris eocaenica. The wall is solid, thin near its upper edge, secondarily thickened below. Externally it is costate, the costae well developed and extending to base. There are either no or only rudimentary costae corresponding to the last cycle of septa, these may be quite tall, but are extremely thin. Intercostal spaces flattish and wide, except where costae correspond to the last cycle of septa. The whole outer surface has a smooth appearance, any granulations present being microscopic.

The septa are in five complete cycles. The primaries and secondaries of equal size, somewhat thicker than the others, their inner ends bounding the columellar space; tertiaries some-



what shorter and thinner; quarternaries shorter and thinner than the tertiaries; the last cycle extremely thin. The courses of the septa are usually curved or flexuous. <sup>A</sup> No perforations. ~~could be discovered.~~ Septal faces with some scattered granulations. There are no pali, but below the bottom of the calice the inner ends of the principal septa are considerably thickened, fusing one to another. A transverse section cut above the level of the upper termination of the columella shows no sign of pali. The interseptal loculi are open. There are neither synapticula nor dissepiments. What Duncan considered synapticula are secondary in origin. The surfaces of the septa can usually be traced through the interseptal masses of calcite.

Columella a more or less flexed lamella, with some sharp processes projecting from the sides. In places it is fused to the principal septa.

The preceding description is based on Duncan's type specimen, and a smaller (younger) specimen, of which a thin section



was cut, and the cut surface of each remaining piece polished.

Duncan's type had been cut and the surface of one piece polished.

I had the other piece polished. I therefore had for study four polished surfaces and one thin section. Excepting size there is practically no difference between the specimens.

The species is a Turbinolid and exhibits no characters by which it could be <sup>separated</sup> differentiated from Placotrochus.



*Asterosmilia compressa*, sp. nov.

Pl. , figs. ; ? Pl. , fig.

1873. Flabellum appendiculatum, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 551.

1899. Flabellum appendiculatum, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 229.

Corallum, compressed, flabelliform and straight or curved in plane of either transverse axis of the calice, attached by a short pedicel, with crests above the pedicel on both edges of the corallum. Calice elliptical.

Measurements and number of septa of specimens.

specimen.	Greater diameter of calice.	Lesser diameter of calice.	Height of corallum.	Number of septa.
1	14.5 mm.	9 mm.	19 mm.	about 68
2	15.5	10	17.5	about 70
3	22.5	14	36	
4	22	10.5	27	about 100
5	26	9.5	35	about 135



As this species must be compared with Duncan's A. abnormalis the measurements of that species, according to him, may be given here.

Specimen	Greater diameter of calice.	Lesser diameter of calice.	Height of corallum	Number of septa.
1	15.3	12.75 mm.	30.6 mm.	
2	20.4	15.3	56.1	

From these measurements it will be immediately noticed that A. compressa is relatively a much shorter coral, is decidedly more compressed than A. abnormalis. The crests above the pedicel seem to be about the same in the two species.

Wall, not very thick, may be secondarily thickened from within, externally coated by pellicular, porcellanous epitheca. Costae distinct, but low, near the base every fourth one is somewhat more prominent than the intervening three, around the top of the pedicel they may alternate in size. They are granulate along the summits.



septa about 100 to 135 in number in adult individuals - five complete cycles, and many members of the sixth. Three or four sizes can usually be distinguished. Usually a rudimentary of the fourth or fifth cycle is present between each pair of larger septa. Pali present before the penultimate septa and when the septa are very numerous as in specimen 5 of the table of measurements for the species the antepenultimate also. They are not very wide, and are rounded above. Endotheca present, but scanty.

Columella, very much compressed, lamellate but perforate,  
Types.---Three specimens (Nos. 1, 2, and 3 of table) in the Academy of Natural Sciences of Philadelphia, and three (Nos. 5 and 6 of table) specimens in the Museum of Comparative Zoology.

Locality.---Santo Domingo (Gabb collection); ? Limestone of St. Bartholomew, P.T. Cleve, Collector, University of Upsala.

Geologic horizon.---Not known.



Remarks.---This species was identified by Pourtales as A. anomala, correctly identified A. anomala (abnormalis is the proper specific name) being in the same tray with it. The differences between the two species have been pointed out in the foregoing description.

A specimen which is probably Duncan's "Flabellum appendiculatum, Progn., sp." from the limestone of St. Bartholomew, belongs to the collection of the University of Upsala. This specimen agrees in external form, size and costal markings with A. compressa. Its measurements are: Greater diameter of calice, 21 mm.; lesser, 12 mm.; height, 26 mm., these dimensions being nearly the same as those of specimen No. 4 of the preceding table. The costae also are very similar. Dissepiments are present, but as the details of the septa and columella are obscured, a positive identification can not be made.



*Asterosmilia pourtalesi* Duncan.

Pl. , fig. .

1873. *Asterosmilia pourtalesi*, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 553, pl. xix, fig. 4

1899. *Asterosmilia pourtalesi*, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, No. 1, p. 229.

Original description:

"The corallum is slightly curved and compressed. The calices are elliptical in outline. The columella is short, stout, and lamellar. The septa are numerous, close, and thin; there are five cycles of them, and the fifth is incomplete in some systems.

The costae are numerous, and alternately large and small.

The endotheca resembles synapticulae; and there is an epitheca. Exotheca well developed.

Height of corallum 1 inch. Length of the calice 5/10 inch.



Loc. In the conglomerate of St. Bartholomew's, West Indies."

In the collection of the University of Upsala, from the P. T. Cleve collection.

Additional note.---The following notes are based upon Duncan's type specimen loaned to me by Prof. Högbom of the University of Upsala.

The specimen is in a poor state of preservation, broken at both the lower and upper end. The piece is 27 mm. long; greater diameter of lower end 12.5 mm.; greater diameter of upper end 13.5 mm.; lesser diameter of upper end, 11 mm. Costae low, alternately larger and smaller. Septa and columella as Duncan describes them.

This species is most closely related to Duncan's A. exarata. The form is practically the same and there is only a little difference in the costae, but A. pourtalesi is decidedly smaller and has one more cycle of septa.



*Trochosmilia hoegbomi* sp.nov.

Pl. , fig.

1901. *Trochosmilia* sp., Vaughan, Quart. Jour. Geol. Soc. London,  
vol. lvii, p. 497.

Corallum compressed conical, attached by a small, pointed base. The best specimen, which is taken as the type, has a greater diameter at the calice of 25.5 mm., lesser diameter 18 mm., height 27 mm. The specimen is somewhat crushed.

Wall rather thick, very compact. Costae distinct, around the calice subequal, as the base is approached every alternate one becomes more indistinct, ultimately disappearing. At the margin of the calice they are decidedly crowded, less so inferiorly. Edges subacute.

Septa thicker at the wall, very much crowded, numerous, about 96, or five complete cycles. The members of the first, second and third cycles appear to be continued to the axial space.



Dissepiments present.

The depth of the calice could not be ascertained.

Columella absent, the principal septa meet in the axial space.

Type.---University of Upsala. P. T. Cleve, Collector.

Locality.---St. Bartholomew, West Indies.



*Trochosmilia spenceri* sp. nov.

Pl. fig.

Corallum compressed conical, attached by a small, pointed base. The best specimen, which is taken as the type, has a greater diameter at the calice of 25.5 mm., lesser diameter 19 mm., height 23 mm. The specimen is somewhat crushed, giving the calice a decidedly irregular outline.

Wall rather thick, very compact. Costae distinct, around the calice subequal, as the base is approached every alternate one becomes more indistinct, ultimately disappearing. At the margin of the calice they are decidedly crowded, less so inferiorly. Edges obtuse, with transversely compressed granulations.

Septa thicker at the wall, very much crowded, numerous, about 96, or five complete cycles. The members of the first, second and third cycles appear to be continued to the axial space. The septa within are much broken and their courses can

the pupils' culture, the teacher's influence on the pupils' culture, and the pupils' influence on their own culture.

The first factor, the pupils' culture, is measured by the pupils' scores on the Culture Inventory.

The second factor, the teacher's influence on the pupils' culture, is measured by the teacher's scores on the Teacher Influence Inventory.

The third factor, the pupils' influence on their own culture, is measured by the pupils' scores on the Pupil Influence Inventory.

The Culture Inventory, the Teacher Influence Inventory, and the Pupil Influence Inventory were all developed by the author.

The Culture Inventory consists of 100 items, each of which has four possible answers.

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not be followed accurately.

Dissepiments present.

The depth of the calice could not be ascertained.

Columella absent, the principal septa meet in the axial space.

Type.---U. S. National Museum. J. W. Spencer, Collector.

Locality.---Antigua, West Indies.

Geologic horizon.---Upper Oligocene, "White Limestone" of J. W. Spencer.

Additional remarks.---Dr. Spencer has brought seven specimens of this species from Antigua, but only one has the outside preserved, and it has been selected as the type. The measurements for the remaining six specimens are as follows:



Specimen	Greater diameter of calice.	Lesser diameter of calice.	Height of corallum.	
1	12 mm.	7 mm.	12 + mm.	
2	17.5	17.5	20	
3	21	15	18	
4	21	12	17 +	
5	24	17.5	20	
6	30	23	?	

As these specimens have been more or less crushed and as the base is not perfect in any instance, the above measurements must be used with discretion. Leaving out specimen No. 2, they indicate as an average that ratio of the lesser to the greater transverse axis of the calice is 100:146 (in the type specimen it is 100:134), and that the height of the corallum is approximately equal to the greater transverse axis of the calice.



*Parasmilia antiguensis* sp. nov.

Pl.      figs.

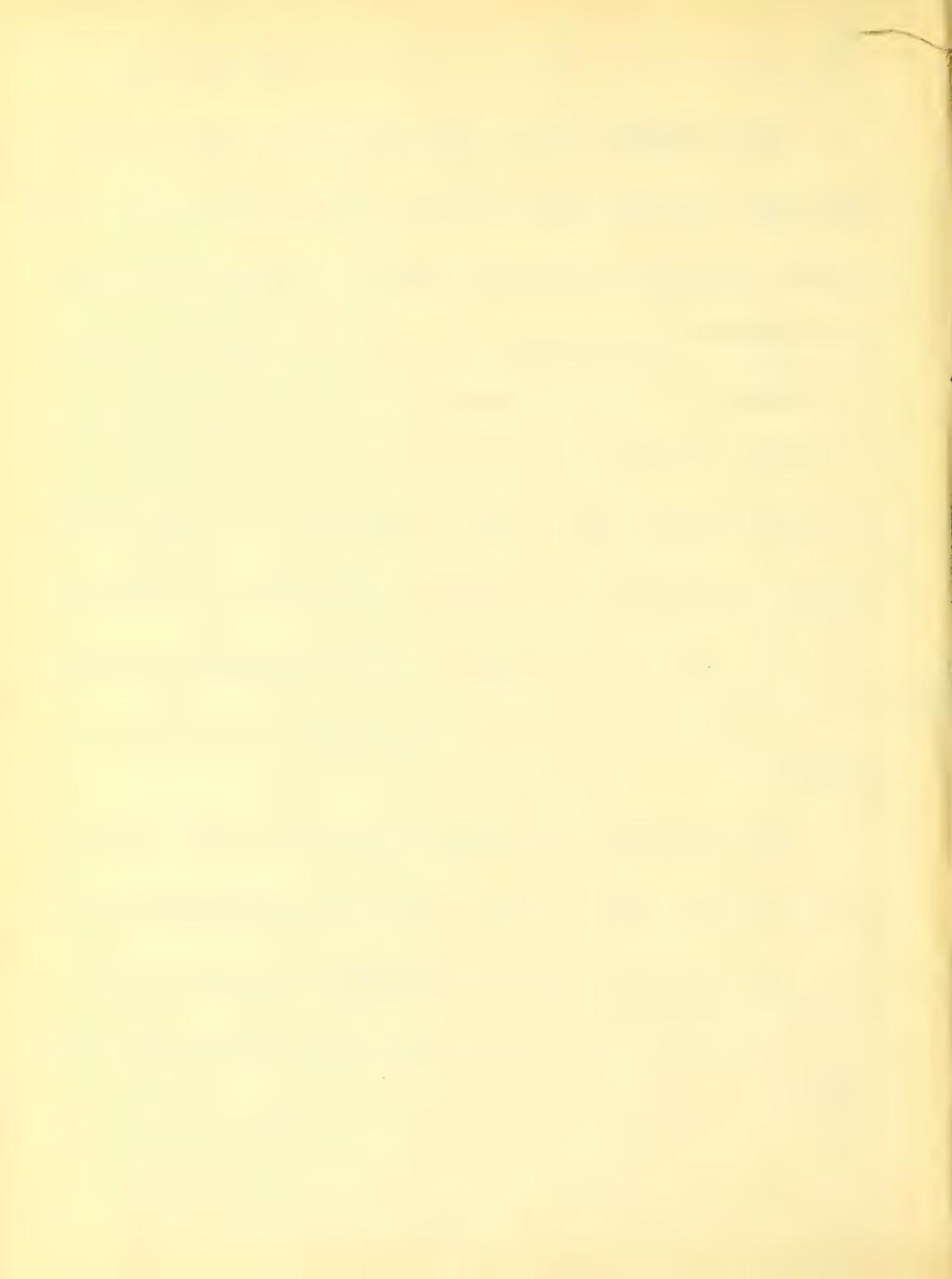
Corallum subturbinate, attached by a stout pedicel, calice subelliptical in outline, in type specimens somewhat constricted. Greater diameter of calice 29 mm.; lesser diameter 26 mm.; greater diameter of corallum in thickest portion 38 mm., lesser, 32 mm.; height of corallum 26 mm. + (base damaged). Another specimen is nearly 30 mm. tall.

Wall at calicular edge only moderately thick, but very much thickened in the lower portion of the corallum. Costae tall, thin. Those corresponding to the first and second and one or two members of the third cycles of septa are very prominent, 1.5 to 3 mm. high. They are slightly sinuous and lamelliform, like projecting plates. The margins appear entire and are obtuse or rounded. Between each pair of these most prominent costae is a less prominent one. There are besides these, small costae corresponding to the higher cycles of septa.



In the specimen that is used as the type, there are thirteen septa that are larger than the others, these thirteen and thirteen thinner ones extend to the axial space. In the twenty-six interspaces between these principal septa there is usually one member of a higher cycle, in one interspace there appears to be no member of a higher cycle, and in one or two interspaces there are two. The total number of septa is 54. According to the usual mode of description, there are four complete cycles with a few members of the fifth. The septa are distant at the wall; they are very thin at their inner ends, becoming gradually thicker as the wall is approached.

Thin endothecal dissegments present in the upper portion of the corallum. The interseptal loculi in the lower portion of the corallum are solidly filled by endoplasm. Exotheca is well developed, there are both thick and thin dissegments between the costae.



The calice is very shallow. Columella, poorly developed, composed of thin irregularly interlacing trabeculae from the inner ends of the septa.

Type.---U. S. National Museum, J. W. Spencer, Collector.

Locality.---Antigua, West Indies.

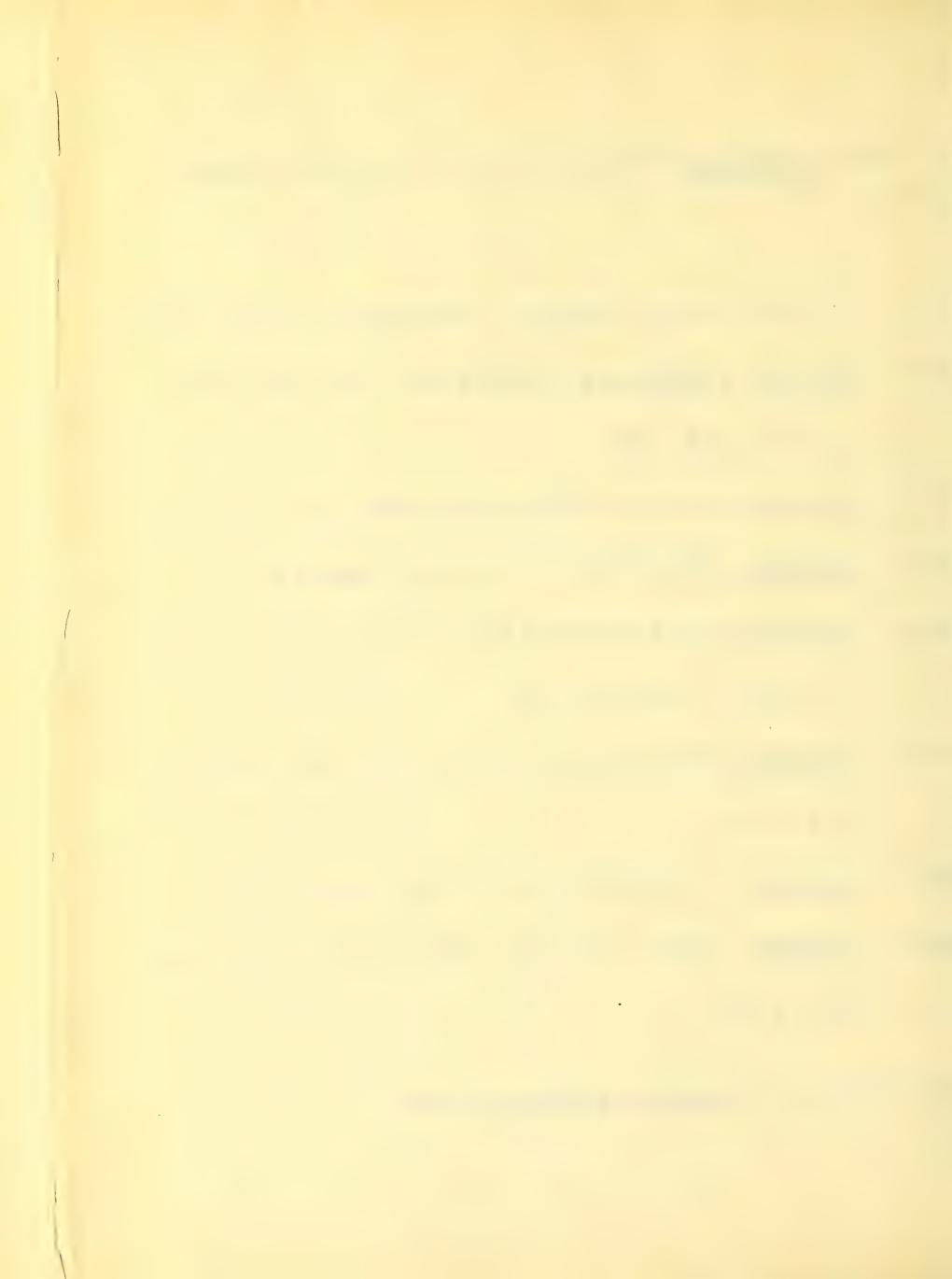
Geologic horizon.---Upper Oligocene (J. W. Spencer's "White Limestone." Matrix, yellow argillaceous limestone or yellow calcareous clay marl.



Genus Stylophora Schweigger emend Milne Edwards & Haime.

1819. Stylophora (pars) Schweigger, Beobacht. auf Naturf., tab. 5.
1830. Stylopora & Sideropora, de Blainville, Dict. Sci. Nat., t. lx, pp. 319, 351.
1835. Anthopora, Gray, Proc. Zool. Soc. London, Pt. III, p. 86.
1846. Sideropora, Dana, Zooph. Wilkes Expl. Exped., p. 517.
1850. Stylophora, Milne Edwards & Haime, Ann. Sci. nat., 3 ieme ser., Zool. t. xiii, p. 102.
1857. Stylophora, Milne Edwards & Haime, Mist. nat. Corale, t. ii, p. 133.
1861. Stylophora, de Fromentel, Intr. Polop. foss., p. 179.
1884. Stylophora, Duncan, Jour. Linn. Soc. London, Zool., Vol. XVIII, p. 45.

Type species. --- Madrepora pistillata Esper.



Generic diagnosis.

Corallum arborescent, palmate or encrusting. Calices with a styliform columella. Septa, six principal that reach the columella, second cycle smaller and may be rudimentary or absent, occasionally third cycle represented by rudimentary septa. Coenenchyma between corallites sub-compact, granulated, often ridged. Costae rudimentary or small. Dissepimental endotheca present, internal cavity frequently obliterated. Asexual reproduction by lateral or intercalicular gemmation.

Duncan in his papers on the Fossil Corals of the West Indies either describes as new or lists the following species:



From the Eocene of Jamaica:

*Stylophora contorta* (Leymerie) + 1 var.

From St. Bartholomew, Cleve collection said to be Eocene:

*Stylophora compressa* sp. nov.  $\downarrow$

*distans* (Leymerie)

*conferta* Reuss.

*tuberosa* Reuss.

*affinis* Duncan (described from Santo Domingo)

*granulata* Duncan (described from Bowden, Jamaica).

*Although Haven studies the collection from St. Bartholomew, submitted to me, he only recognizes one species which I have divided into four varieties (sup.).*  
From the Upper Oligocene, old Miocene.

of Santo Domingo:

*Stylophora affinis* sp. nov.

var. minor var. nov.

*raristellata* (de France).

of Bowden, Jamaica:

*Stylophora granulata* sp. nov.

of St. Croix, Trinidad:

*Stylophora minuta* sp. nov.

*raristellata* (de France).

*mirabilis* Duncan (non Duch. & Mich.)



I described in 1900:

*Stylophora ponderosa* from the Lower Oligocene of Salt Mountain, near Jackson, Alabama, and

*Stylophora minutissima* from the basal Upper Oligocene of Blue or Russell Spring, near Bainbridge, Georgia.

The following are here described as new species:

*Stylophora mammillata*, Upper Oligocene, near Bainbridge, Georgia.  
*decaturensis*, Upper Oligocene, " " "  
*silicensis*, Upper Oligocene, Ballast Point, Florida.  
*alumensis*, Upper Oligocene, Alum Bluff, Florida.  
*monticulosa*, Upper Oligocene?, Santo Domingo, W.I.  
*antiguensis*, Upper Oligocene, Antigua, W. I.

I have recognized as valid the four species described as new by Duncan, and the eight described by myself, and an attempt is made to present in the accompanying Key their salient differences in tabular form. Duncan's identification of West Indian specimens with European species ~~and his notes on them~~ are given in a kind of appendix. Every one of these determinations of Duncan is open to the gravest doubt, almost certainly they are all wrong.

*are all discarded as*



## Key to Species.

Calices with extended upper lip.

Corallum ramoso, forming thick cylindrical or slightly compressed branches. St. affinis Duncan.

Calices without extended upper lip.

Corallum ramoso.

Surface of branches with monticules -- St. monticulosa Vaughan

Surface of branches without monticules

Branches large compressed,

no elevated line between calices, second cycle of septa usually well developed - St. antiguensis Vaughan  
with distinct, elevated line between the calices,  
~~usually absent~~ second cycle of septa ~~rudimentary~~ - St. compressa

Duncan.

Branches small compressed,

calice shallow, second cycle of septa present,

St. alumensis Vaughan.

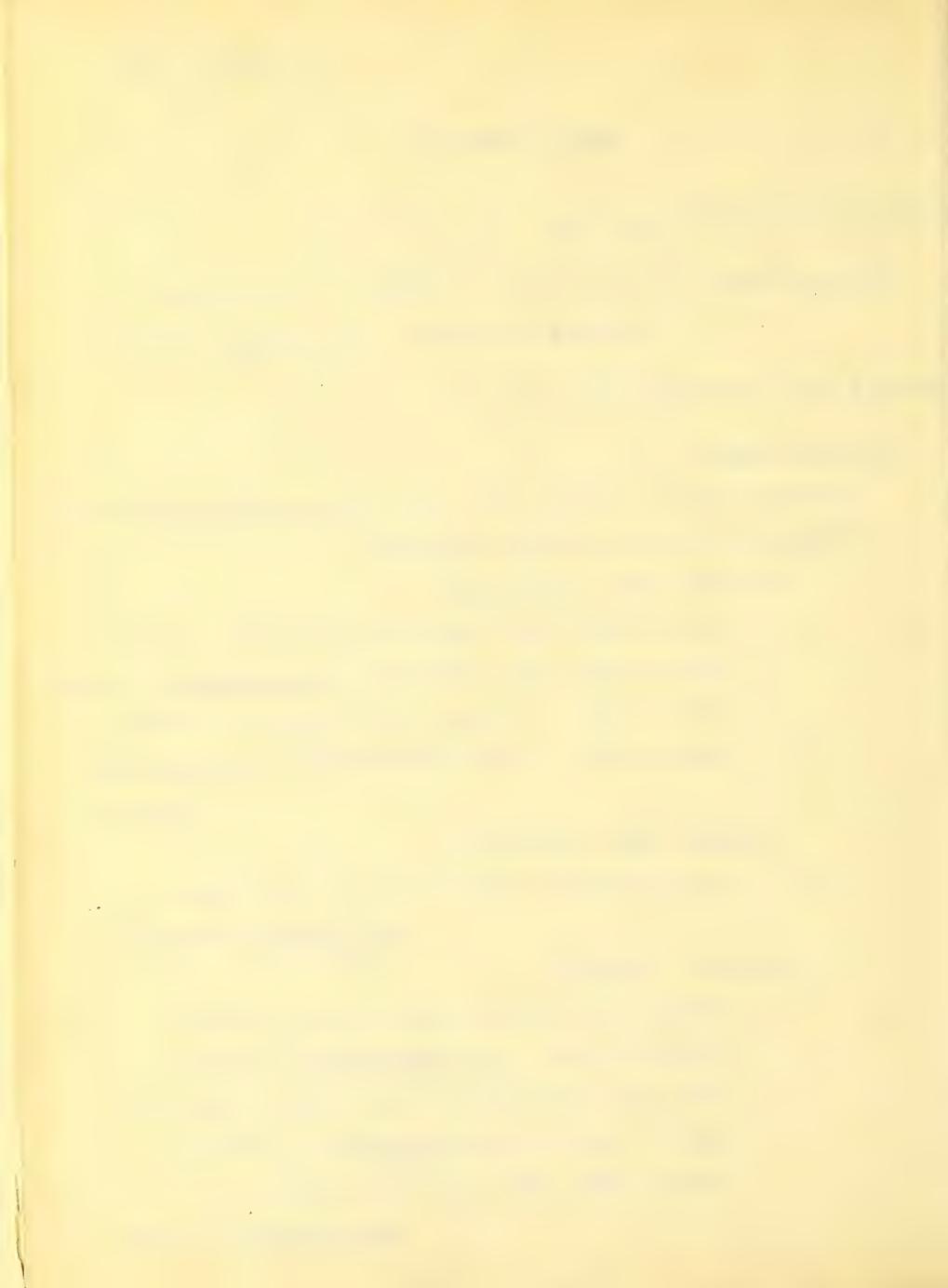
Branches elongate,

extremely ~~alternate~~, calices about .5 mm. in diameter ----- St. minutissima Vaughan

often much ~~alternate~~, calices shallow, 1 mm. in diameter ----- St. silicensis Vaughan

calices deep, about 1 mm. in diameter,

St. granulata Duncan.



Corallum small with flattened, thick, crispate and lobate fronds,

St. decaturensis Vaughan.

↑  
Corallum encrusting

calicular rim not elevated, 2 cycles of septa,

St. mammillata Vaughan.

calicular rim elevated, 1 cycle of septa,

St. minuta Duncan.

Corallum very large and massive ---- St. ponderosa Vaughan.

Corallum ramose or glomerate.

Branches rather large with much compressed ends, grading into forms with a nodular upper surface.

Six septa, second cycle very rarely represented by rudimentary septa.

St. compressa Duncan



*Stylophora affinis* var. *minor* Duncan.

1863. *Stylophora affinis* var. *minor*, Duncan, Quart. Jour. Geol.

Soc. London, Vol. XIX, p. 436.

Duncan gives the following as the diagnostic characters of this variety:

"A portion of a branched Stylophora in a mass of shell- and coral-breccia from the Nivaje shale differs from the typical form of S. affinis by having its calices much wider apart, and consequently by having more coenenchyma. It is a small form; the calices are about the same size as those of the larger variety where, however, they are closer together.

This new species and its variety are closely allied to Stylophora costulata, Edwards & Haime, from Gaas (Miocene), and less so to Stylophora raristella (Dax and Turin). In some very large specimens there are irregular gibbosities, like truncated shoots, from the main stem; and the Jamaican specimens often



present this form of corallum in small branches. The imperfect septal development and defective costal arrangement distinguish the new species from S. costulata, but still the alliance is very close. Apart from the form of the coral, there is much resemblance to Stylophora palmata (recent, Red Sea). The fossil forms are from La Palarea, Scinde, Biarritz, Dax, Turin, Vienna, Belforte, and Gaas."



*Stylophora gabbi, sp. nov.*

Pl. fig.

*growing in low clumps*

Corallum forming small, somewhat compressed branches, on

1

which are rounded monticules or small rudimentary branches that make an acute angle with the main branch.

Calices, shallow, small, barely .5 mm. in diameter, irregularly scattered over the surface of the corallum, and except on the rudimentary branches or monticules usually distant, often as much as three their diameter. There is no elevated calicular

rim. The coenenchymal surface is ~~worn but faint vestiges of~~ *densely granulate, granulations*

~~Small, 24 or more minute costae~~  
~~about 12 costae may be seen around some calices, and there are~~

~~granulations.~~ The coenenchyma is ~~very~~ solid; the axis of the corallum vesiculate.

*principal and rudimentary*

Septa, six, ~~no~~ members of a second cycle could be found.

A

They are considerably thicker at the wall, their median portion thin, thicker again where they join the columella.

Endothecal dissepsiments very well developed.



Columella, appears to be terminated, when perfect, by  
a prominent pointed style that reaches to the level of the  
calicular margin.

Locality.--- Santo Domingo (Gabb Collector).

Geologic horizon. ---Oligocene?

Geol. Soc. London No. 12883  
Type.---~~Academy of Natural Sciences of Philadelphia.~~

A specimen also in coll. Acad. Nat. Sci. Phila. Pl.  
fig. illustrates the type, on which the description is based.



*Stylophora monticulosa* sp. nov.

Pl.

fig.

Corallum forming small rounded or compressed branches which apparently in some instances may be lobate around the upper ends; numerous monticules varying from 2 to 5 mm. in diameter at the base and attaining a height of about 2 mm. are scattered over the surface. The calices are small, moderately deep, the usual diameter .5 to .75 mm. They have no recognizably definite arrangement and are separated by about their own diameter. Frequently there is a very slightly raised calicular rim, around which there are about eighteen costae, which may be very short or extend from one calice to the next. The coenenchymal surface between calices is partly costate and partly granulate, where it is perfect usually a faint elevated line marks the limits of adjoining zooids. The cross section of a branch shows a spongy axis, outside of which the coenenchyma between the corallites is very solid; along the corallite cavities are dissepiments, about



6 in 2.5 mm., or slightly less than .5 mm. apart.

There are six septa that extend to the columella, these are decidedly thicker at the wall, thin in their median portion, and somewhat thicker around the columella; the second cycle is rudimentary or absent. Columella rather stout, upper end roundish.

Types.---Three specimens in the Museum of Comparative Zoology.

Locality.---Santo Domingo.

Geologic horizon.---Oligocene? <sup>W</sup>

This species is the same as Duncan Stylophora affinis var. 2 (Quart. Jour. Geol. Soc. London, vol. xx, p. 27). The type specimen of the variety is No. 12905. There are two other specimens that bear no number. Sp. No. 12905 is photographed. Note especially that the upper lip of the calice may be more prominent than the lower. This coral is very close to Stylophora affinis.



*Stylophora*

Stylophora antiguensis sp. nov.

Pl. figs.

1901. Stylophora sp. Vaughan, Quart. Jour. Geol. Soc. London,  
Vol. LVII, p. 497.

1902. Stylophora sp. Vaughan, Quart. Jour. Geol. Soc. London,  
Vol. LVIII, p. 358.

Corallum ramosa, branches flattened, large in lower portion,  
the terminal branches sometimes much compressed, may be swollen  
at the ends. The views of the specimens Pl. , figs.  
give a correct idea of the form and size of two specimens.

The calices are shallow, irregularly arranged, their  
diameter averages about 1 mm., they are separated by coenenchyma  
varying from a very narrow ridge to as much as 1 mm. across in  
very rare instances, usually the distance from one calice to the  
next is about half the diameter of a calice. There is either no  
elevated calicular rim or only an extremely slight depression be-



tween the calices. Costae quite often are well developed, there may be as many as 18 to 20 around a calice; they have rather coarse granulations along their courses; in some instances, only granulations are seen on the coenenchymal surface. No elevated ridge between the calices was perceived.

There are six large septa, reaching the columella, and usually six well developed members of the second cycle, occasionally one of this cycle may extend to the columella. The septal margins are never prominent, quite often or usually they do reach the level of the surface of the coenenchyma. Dissepiments present.

The columella with a roundish tip, does not quite reach to the level of the rim of the calice.

Types.---U. S. National Museum, 3 specimens (J. W. Spencer Collector).

Localities.---Antigua, West Indies, and Bridgetown, Barbados, West Indies.

Geologic horizon.---Basal Upper Oligocene.



*Stylophora compressa* Duncan.

Pl. fig.

1873. *Stylophora compressa*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIX, p. 551, Pl. XIX, figs. 5, 5a.

1899. *Stylophora compressa*, Vaughan, Bull. Mus. Comp. Zool.

Vol. XXXIV, p. 229.

Original description:

"The corallum is ramosc; and the branches are flattened out, but thick.

The coenenchyma is well developed; and there is much space between the corallites in some parts, and less in others. It is very faintly granular, and is marked by a ridge which meanders between the calices, and includes them in more or less geometrical meshes.

The calices are small, and are surrounded by a raised rim, which is rather wavy.



six principal septa reach the small styloid columella.

The other septa are rudimentary.

Loc. ---The limestone of St. Bartholomew's, West Indies.

In the collection of the University of Upsala, and of Mr.

T. P. Cleve, of Stockholm. "



*Stylophora compressa typica.*

Pl. , figs.

Duncan's original description will precisely apply to this variety. The corallum is ramous, the branches often decidedly compressed, plate-like, free to a considerable extent, the surface is without monticules (several small flattened branches are represented by pl. , figs. ). The calices average larger than in the varieties subsequently to be described, usual diameter, 1 mm.

*Stylephora compressa var. subnodosaa nov.*

Pl. , figs.

This variety is separated from the typical form by having the branches reduced in length. The sides of the corallum may have broad longitudinal furrows between more or less compressed or rounded ridges, in these cases the branches are fused together through a great portion of their length, they terminate, however,



*Stylophora compressa* var subnodosa

in lobes or nodules. In other cases lateral branches may be arrested in development and form gibbosities on the surface.

Pl. , figs. represent several of these specimens. A study of the large suite of specimens reveals no sharp line of division between typical compressa and the specimens that are designated var. subnodosa. The calices of subnodosa will average smaller, about .7 mm., than in the typical form, but in this feature the two varieties overlap.

*Stylophora compressa* var. grandinodosa nov.

Pl. , figs. .

This variety is separated from the preceding by an increase in the size of the nodules, the two specimens referred to it are represented by pl. , figs. .



*Stylophora compressa* var. *parvinodosa* nov.

Pl. , figs. .

This variety differs from var. grandinodosa by its smaller and more numerous nodules, the intergradation between the two seems complete.

As the preceding two varieties have been described only in a comparative way, an actual description of the present one is given.

The corallum is rather small, growing upward from a relatively large base. The dimensions of a small specimen with fractured base are: Greater diameter of base, 20 mm.; lesser, 13 mm.; height, 17 mm.; greatest width of corallum 32 mm.; lesser 22 mm. Larger specimens exceed 50 mm. in height. The outer surface is very uneven, with numerous gibbosities and there may be larger lobulations. The gibbosities are very variable in size, the larger ones possessing a greater diameter of as much as 15 mm., the smaller ones not exceeding 4 mm. They also vary in



prominence from only slight elevations to almost 10 mm. In cross section they are elliptical and the inside is porous. The ends are rounded, may be somewhat swollen, in most instances they are broken and have a hollow interior.

The calices are .6 to .7 mm. in diameter, and are separated by a thickness of coenenchyma equal to or less than their own diameter. Calicular margins very slightly or not at all elevated. The sculpture of the coenenchymal surface eroded and obliterated.



*Stylephora anguillensis* sp. nov.

Plate , Figs.

Corallum ramosa, branches irregular in shape, Pl. , figs.  
represent three, natural size.

Calices medium sized, .7 to .9 mm. in diameter, may be crowded or separated by as much as 1 mm. of coenenchyme. Surface of the coenenchyma densely and rather coarsely granulate, the granulations sometimes arranged as costae. On some specimens frequently there are conical elevations of the coenenchyma similar to the styles of Stylocoenia. They may be absent over considerable areas, on others they may be abundant. Not infrequently a pore exists in the tip of each style. These styles may be pathologic and not a true structural character. Calicular fossa rather shallow, calicular rim not elevated.

Septa, six principals and six short ones. The second cycle is quite well developed.

Columella terminated by a delicate-pointed style that does not reach to the level of the coenenchymal surface.

Locality: Island of Anguilla, West Indies; P. T. Cleve, collector.

Geologic horizon: Upper Oligocene.

Type: University of Upsala. Duplicate specimens in the United States National Museum.



The collection of the University of Upsala contains two broken clusters and four fragments from Anguilla, West Indies, that apparently belong to this species. I can discover no characters by which they can be separated from S. alumensis, the surface, however, is eroded and perfect specimens might show differences. Pl. , figs. represent the two best specimens.



*Stylophora minutissima* Vaughan.

Pl. figs.

1900. *Stylophora minutissima*, Vaughan, Mon. XXXIX, U. S. Geol.

Surv., p. 131, Pl. XIII, figs. 13 to 15.

1900. *Stylophora minutissima*, Vaughan, Science, N. S., Vol. XII,

p. 873.

Original description:

Pasted on 1st copy



## Stylephora silicensis sp. nov.

Pl. figs.

Corallum rameose, forming rather small clusters with branches of two kinds, first, very much attenuated, preserving nearly the same diameter throughout a considerable length, then gradually tapering to a rounded end, others are shorter and thicker and have bluntly rounded or compressed terminations. The long slender branches are usually almost terete, but some are compressed, this is especially true where new branches are formed by trifurcation of the old. Pl. , figs. , represent the different forms of the branches and also gives a correct idea of their size.

Calices shallow, on the long branches arranged along rather definite lines parallel with the axis of the branch or along slightly twisted spirals, sometimes the arrangement is irregular. In outline they are circular or slightly elliptical. Usual diameter, 1 mm. The calicular rim is slightly elevated, with a



tendency to be somewhat swollen around the base, or is level with the surface of the coenenchyma. There is no projecting upper lip to the calices. Costae about 18 in number, distinct around the rim, in some instances they are short, in others they are prolonged until they meet those of the next calice. The limits of the zoids indicated by a fine raised line or the coenenchymal surface is granulate, without such a line.

There are six stout principal septa that extend to the columella, vestiges of the second cycle can rarely be discovered within the calice, but usually between each pair of costae corresponding to the septa of the first cycles are two costae.

The columella is terminated by a low style, it is very much thickened below, where the principal septa fuse to it.

Types.--U. S. National Museum, nine specimens, and one specimen in the Wagner Free Institute of Science of Philadelphia.

Locality.--Ballast Point, Tampa, Florida; some specimens which may be this species were collected by me at Blue Spring, Flint River, near Bainbridge, Georgia.

Geologic horizon.--Upper Oligocene, Tampa Silex beds.



*Stylophora decaturensis* sp. nov.

Pl. figs.

Corallum small, forming comparatively thick, crispate and lobate fronds.

Calices, shallow, irregularly arranged, very small, diameter from about .25 to .35 mm., very rarely as much as .5 mm., they are crowded on the ends of the lobes, but are distant on the expanded portion of the frond, as much as 1 mm. The calicular rims are not at all or are scarcely perceptibly elevated. Distinct costae usually do not extend beyond the margin of the calice. Coenenchymal surface very densely and minutely granulate.

The septa are small, weak, there are six principal ones, and the second cycle is usually complete, these being very small. The upper septal margins are not prominent, but are distinct around the edge of the calice. Two opposed septa are stronger than the others, so that in weathered calices a longitudinal partition remains. Minute dissements present.



Columella a delicate style, apparently with a rounded termination, and not quite reaching to the level of the calicular margin.

Type.---U. S. National Museum. There are two specimens besides the type, three in all.

Locality.---Blue or Russell Springs, Flint River, 4 miles below Bainbridge, Georgia.

Geologic horizon.---Basal Upper Oligocene.



*Stylephora mammillata* Vaughan.

Pl. fig.

Corallum, small, encrusting, with the upper surface thrown into gibbosities.

Calices shallow, superficial, diameter 1 mm., crowded, separated by only a thin wall, or by coenenchyma sometimes as much as 1 mm. across. The calicular margins either are not elevated, or there may be a slight rim on one side. Costae are absent or indistinct. The coenenchymal surface is densely granulate, and there is no elevated thread between the calices.

There are six quite stout principal septa fusing to the columella, and six short but still usually well developed septa of The peripheral ends of the principal septa are often produced into the second cycle. A stout, erect tooth.

Columella terminating in a bluntish style which reaches the level of the coenenchymal surface.

Type.--U. S. National Museum.

Locality.--Flint River, 4 1/2 miles below Bainbridge,



Decatur County, Georgia.

Geologic horizon.---Upper Oligocene, Bainbridge Chert.



*Stylophora minuta* Duncan.

1867. *Stylophora minuta*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIV, p. 14.

## Original description:

"The corallum is encrusting and very small and thin. The calices are circular in outline, and project like small cylinders above the coenenchyma, which separates them. The costae are not in existence, but the cylindrical wall is plain. The septa are six in number, and are stout. The columella is large and stylecid. The coenenchyma is lax and plain. There are two calices and the intermediate coenenchyma is  $1/10$  inch.

Locality. St. Croix, Trinidad.

This species is closely allied to *S. raristella*, Defrance, sp., of the Faluns.



*Stylophora ponderosa* Vaughan.

Pl. figs.

1900. *Stylophora ponderosa*, Vaughan, Mon. XXXIX, U. S. Geol. Survey, p. 132, Pl. XIII, fig. 16, Pl. XIV, figs. 1 to 1b.

Description based on original copy

f. 348 86-



European species identified from the West Indies  
by Duncan.

*Stylophora raristella*, var. 1 Duncan.

1863. *Stylophora raristella*, var. 1, Duncan, Quart. Jour. Geol. Soc. London, Vol. XX, p. 27.

1867. *Stylophora raristella*, Duncan, Quart. Jour. Geol. Soc. London, Vol. XIV, pp. 15, 25.

In 1863, Duncan reports this species from the silt of the Sandstone plain, San Domingo, making the following remarks: "A large cylindrical corallum with a central cavity; it is an immense branch of a large variety of the well-known European Miocene form. Thickness of branch 2 1/2 inches." Coll. Geol. Soc. London.

In 1867, he identifies specimens from St. Croix Trinidad as this species. He states that it "is an abundant fossil; and very beautiful examples of the papillate coenenchyma between the calices are very common. There is no coenenchyma in the young



corallum, but it appears with growth. The S. minuta is closely allied to the S. raristella, which is a characteristic Falmnian coral." The location of these specimens is not given.

These Trinidad specimens are in the collection of the Geological Society of London, Nos. 12974, 12975. Their state of preservation is too poor for them to be positively identified. The growth form is encrusting or massive. Calices small, about .5 mm. in diameter and are separated by a mere ridge of a wall or coenenchyma as much as 1 mm. wide. The coenenchymal surface is densely granulate. Septa in two well developed cycles.

The specimen that Dunca has labeled Stylocoenia (listed as Stylophora) mirabilis Duchess. & Mich. (No. 12976, G. S. L.) is the same thing precisely and has nothing to do with the Duch. & Mich. species.

According to Duncan's description of his Stylophora minuta both Duncan's S. raristella and S. mirabilis from St. Croix, Trinidad, should be referred to the same species.



Stylophora contorta (Leymerie) Duncan.

1864. Stylophora contorta, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXI, p. 9.

1867. Stylophora contorta, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, p. 25.

Duncan says, 1864, "A common coral in the Black Shale of Port Maria, Jamaica. It also occurs at La Palarea and in Sinde."

He also speaks of a variety, with thick septa, from Port Maria.

In collection of the Geol. Soc. London, No. 12759, are seven specimens glued to a board and so labeled. Five of the specimens are Stylophora and all appear to belong to the same species, one specimen is a Madracis, and the other Astrocoenia or Stylococenia.

Corallum ramosa, branches blunt, rounded on ends, nearly circular in cross-section. Calices shallow, about 7.5 mm. in diameter, .5 to 1 mm. apart. The surface is badly worn but apparently calicular rim scarcely elevated. Surface of coenenchyma granulated and short costae around edge of calices. Septa in two cycles, six principal and six smaller.



*Stylophora distans* (Leymerie) Duncan.

1873. *Stylophora distans*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIX, p. 551.

1899. *Stylophora distans*, Vaughan, Bull. Mus. Comp. Zool., Vol.  
XXXIV, p. 229.

Duncan reports this species from the Island of St.  
Bartholomew, Cleve Collector.



*Stylophora conferta* Reuss, Duncan.

1873. *Stylophora conferta*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIX, p. 551.

1899. *Stylophora conferta*, Vaughan, Bull. Mus. Comp. Zool.,  
Vol. XXXIV, p. 229.

Duncan reports finding this species in the collection made  
by Cleve in St. Bartholomew.



*Stylophora tuberosa* Reuss, Duncan.

1873. *Stylophora tuberosa*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIX, p. 551.

1899. *Stylophora tuberosa*, Vaughan, Bull. Mus. Comp. Zool.,

Vol. XXXIV, p. 229.

According to Duncan Cleve collected this species in St.

Bartholomew.



*Madracis dominicensis*, sp. nov.

Pl. fig.

1877<sup>5</sup>. *Astrocoenia decaphylla*, Pourtales, Geol. Magazine,

Corallum ramosa, size and form of branch shown by Pl.

Fig. Axis spongy. Corallites polygonal, calices within subcircular or elliptical. Wall between corallites usually less than .5 mm., very rarely as much as 1 mm. in thickness. The upper edge acute, ornamented with a single series of rounded granulations that correspond to the principal and rudimentary septa.

Calices sunken, diameter 1.5 to 2.5 mm.

Septa, ten well developed principal ones, that fuse to the columella. Above the level of their fusion to the columella they are very narrow, being in their upper portion mere ridges along the inside of the corallite wall. The margins possess faint dentations. A second cycle is represented by low septal ridges alternating with the principal septa, in only one instance were these secondary septa at all well developed - in this calice there are fifteen principal septa.



Very thin endothecal dissements numerous.

Columella well developed, the principal septa have their inner ends thickened around it. Termination of style not prominent and usually compressed.

Locality.---Santo Domingo (Gabb Collector).

Geologic horizon.---Oligocene?

Type.---Museum of Comparative Zoology.



Genus Pocillopora Lamarck.

1816. Pocillopora (pars), Lamarck, Hist. Nat. Anim. sans Vert., t. II, p. 273.
1846. Pocillopora Dana, Zooph. Wilkes Explor. Exped., p. 523.
1850. Pocillopora, Milne Edwards & Haime, Monogr. British foss. Corals, Introd., p. lxii.
1860. Pocillopora, Milne Edwards, Hist. nat. Corall., t. iii, p. 301.
1870. Pocillopora, Verrill, Trans. Conn. Acad., Vol. I, p. 519.
1884. Pocillopora, Duncan, Jour. Linn. Soc. London, Zool., Vol. XVIII, p. 47.

Type species.---Pocillopora acuta Lamarck.

Lamarck (op. sup. cit.) referred seven species to this genus. P. acuta is the first, and was designated in 1850 as the type-species by Milne Edwards & Haime.



Duncan (op. sup. cit.) gives the following description of the genus:

"Colony of clusters of branches, or lobes, or fronds of various dimensions, which arise from a more or less compact incrusting base. Branches often with rudimentary branchlets or verrucose. Corallites crowded terminally, angular, and closely united by their walls; on the sides of branches they are more or less separated by compact coenenchyma which is sharply spinulose or granular. Calices small, may be deep or shallow, circular or angular, often filled, below the surface, by a solid deposit. The corallites are crossed by tabulae. Septa narrow, often rudimentary, especially in the crowded calices at the ends of branches, in others longer, usually twelve in number, six larger than the others. Columella when present small, solid little prominent on the upper tabulae. Tabulae often incomplete in middle. Increase by gemmation. Fissiparity very rare. Polyps with 12 tentacles, and a single pair of long mesenterial filaments."



Pocillopora crassoramosa Duncan.

Pl.           figs.

1864. Pocillopora crassoramosa, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XX, p. 40, Pl. V, figs. 2a, 2b.
1866. Pocillopora crassoramosa, Duchassaing & Michelotti, Sup.  
Corall. Antilles, p. 105 (of reprint).
1867. Pocillopora crassoramosa, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 25.
1870. Pocillopora crassoramosa, Duchassaing, Rev. Zooph., p. 33.

The following is Duncan's original description:

"Corallum dendroid, with large cylindrical branches, which are thick, long, and marked, on one side only, by verrucosities; these are sharp, wart-like elevations, covered with calices, and placed, more or less, in longitudinal parallel series, at all heights of the Coral. Calices numerous, small, nearly circular,



and very equal in size. Columella small and often not to be seen; where it exists, some small papillae are also seen, and ten or twelve rudimentary septa likewise. Fossa shallow. Intercalicular tissue dense and sparsely granular on its free surface, where there are often seen irregular polygonal lines. Costae none. Tabulae vary in thickness. The centre of the branches is occupied by lax longitudinal corallites, without intercorallite tissue. Thickness of branches from  $1\frac{1}{2}$  inch to  $\frac{8}{10}$  inch; diameter of calice about  $\frac{1}{20}$  to  $\frac{1}{30}$  inch; diameter of intercorallite space  $\frac{1}{12}$  to  $\frac{1}{20}$  inch.

From the Nivaje shale, San Domingo. Coll. Geol. Soc."

There are three specimens of this species in the collection of the Museum of Comparative Zoology and one in that of the Academy of Natural Sciences of Philadelphia. Duncan's description is quite satisfactory, I can add, however, that the verrucosities may occur on all sides of a branch, the terminal of a nearly perfect small branch is blunt, and that the calices vary from 5 to 1 mm. in diameter.



*Pocillopora tenuis* Duncan.

Pl. figs.

1867. *Pocillopora tenuis*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIV, p. 21, figs. 5a-5c.

The following is Duncan's original description:

"The corallum is large; but the amount of intercorallite coenenchyma is small everywhere, whilst it barely exists in some parts. The tabulae are very delicate, rather and unequally close, and are often marked with a projection -- the columella. The intertabular spaces do not fill up with coral tissue. The septa are small, very distinct, and are usually twelve in number; but in some calices there are a few rudimentary septa.

The corallites are usually crowded, and six occupy about  $1/2$  inch.

Loc. ---Antigua (Coll. Brit. Mus.).



The delicate tabulae and the patency of the intertabular spaces distinguish this species. It is interesting to observe in the same specimen portions without coenenchyma and portions with it, especially as these two conditions are considered generic in Palaeozoic corals! Pocillopora crassoramosa, nobis, has much coenenchyma; and so has P. Jenkinsi, Reuss, its nearest ally, from Java.



*Stephanocoenia reussi* Duncan.

Pl. figs.

1867. *Stephanocoenia reussi*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, pp. 19, 23, Pl. II, fig. 1.

Original description:

"The corallum is gibbose and massive; the corallites vary somewhat in size, but are polygonal, and are separated by consolidated walls, upon which the septo-costal ends are seen. The septa are distinct and distant; there are ten large and ten small. The ten largest septa either reach the columella, or are attached to large pali; ordinarily five or six of the large septa have pali. The pali are long and are broader than the septa; sometimes two of the smaller septa unite to a larger septum. Columella distinct and large. Young corallites have evidently six systems; but the third cycle is incomplete in all the larger corallites.



Diameter of corallites  $\frac{3}{40}$  inch.

Loc., Antigua, and probably from the Marl. (Coll. Brit.

Mus.)



*Stylocoenia pumpellyi* (Vaughan).

Pl. figs.

1900. Astrocoenia pumpellyi, Vaughan, Mon. XXXIX, U. S. Geol.

Survey, p. 149, Pl. XVII, figs. 7, 7a.

1900. Astrocoenia pumpellyi, Vaughan, Science, N. S., Vol. XII,

p. 873.

Original description:

Pasted on 1st copy



The type specimen of this species is a worn specimen and did not show the pillars characteristic of Stylocoenia. However, in the fall of 1900 while collecting along the Flint River, near Bainbridge, Georgia, I procured some very good material, which shows conclusively that the species is a Stylecoenia and not an Astrocoenia. By using these specimens I am able to furnish the following revised description:

Corallum encrusting, forming masses as much as 75 mm. thick, with the upper surface thrown into gibbosities.

The corallites may be crowded, as was originally described for the type specimen or they may be separated by walls sometimes as much as 1 mm. across. When the wall is rather thick its upper surface is densely granulated and often there are short costae around the edges of the calices. Distinct, rather pointed pillars, which possess granulated longitudinal striations, are common over the surface of the corallum. These usually, if not always, are connected with a large septum of a calice. Diameter of the calices, from 1 to 1.5 mm.



Septa, twelve in number, six large reaching the columella, and six shorter. Their margins seem to be finely dentate, but of this I can not be positive. Should they possess dentations, the species could not properly be referred to Astrocoenia, if the original generic diagnosis is correct.

Thin dissepsiments present.

Columella well developed, terminated by a prominent, rather pointed style.

Additional locality.---Holes Landing, Flint River, 7 miles below Bainbridge, Georgia. *Antiquus*.

Geologic horizon.---Basal Upper Oligocene.

Remarks.---This coral resembles most closely Astrocoenia decaturensis, the latter has sixteen septa, eight large and eight small, and has no pillars on its upper surface, the former has twelve septa and has pillars.



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*Astrocoenia decaturensis*, sp. nov.

Pl. fig.

Corallum massive, rather large, upper surface with numerous gibbosities. One specimen has a base 14 by 17 cm, respectively as the smaller and greater diameter, and is about 8 cm. in height, another has 19 cm. as the greatest diameter of the base.

Corallites polygonal, separated by walls that are never very thick, rarely as much as 1 mm., upper edge usually if not always marked by a small raised, granulated line. The distal ends of the septa are produced as short costae to this line and quite often a granulation occurs between each pair of costae. The diameter of the corallites varies from 1.5 to 2.5 mm., about 2 mm. is the average. Calices shallow.

Septa distant, normally sixteen in number, of which eight extend to the columella, occasionally twenty, with ten reaching the columella. Their outer ends are slightly prominent on the wall, and are equal in size. The inner margins lie almost in a



straight line or are very slightly excavated, but are regularly finely dentate, with four to seven teeth to each septum. These teeth are moderately acute and are directly obliquely upward and inward. Granulations on the faces minute, pointed.

Endothecal dissepsiments present, thin, not abundant.

Columella a strong style, upper end pointed, but not very prominent. There is some thickening of the inner ends of the larger septa, where they fuse to the columella.

Locality.---Hall's Landing on Flint River, 7 miles below Bainbridge, Georgia, and Blue Springs, 4 miles below Bainbridge; also the Island of Antigua, West Indies.

Geologic horizon.---Basal Upper Oligocene.

Types.---United States National Museum.

*Astrocoenia vonata* Buman from Antigua No. 12948 G.S.L., massive, thickened, corallites crowded, polygonal, intervening walls thin, diam. corallites, 1.5 to 1.75 mm. Septa, 8 principal, 8 rudimentary, thin and distant. Columella, slender style.



*portoricensis*  
*Astrocoenia antiguensis* sp. nov.

Pl. fig.

1863. *Astrocoenia ornata*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XIX, p. 425, Pl. XIV, fig. 7.
1867. *Astrocoenia ornata*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIV, p. 23.
1901. *Astrocoenia ornata*, Vaughan, Quart. Jour. Geol. Soc.  
London, Vol. LVII, p. 497.

Non.

1838. *Porites ornata*, Michelotti, Specim. Zooph. diluv., p. 172,  
Pl. VI, fig. 3.
1857. *Astrocoenia ornata*, Milne Edwards & Haime, Hist. nat.  
Corall., T. II, p. 257.

Duncan with his usual propensity for misidentifying West  
Indian corals with European species to which there was even a  
suggestive resemblance, referred the present species to the



Astrocoenia ornata (Michelotti). As I had not described the species and given it a new name I followed Duncan's nomenclature in the list of corals from Antigua furnished by me to Dr. J. W. Spencer.

Description:

Corallum, not very large, forming flattened, even palmate branches. The type specimen has a greatest width of 39 mm. and a thickness of 9 or 10 mm.

Corallites polygonal, united by compact not very thick walls, its width .25 to .5 mm. The distal ends of the septa form not especially prominent costae. Diameter of the corallites from 1 to 1.5 mm. Calices shallow.

Septa, sixteen in number, eight reach the columella and eight are short or even rudimentary. Occasionally a few dentations may be seen on the margins, but they usually have been worn away.



Endothecal dissegments present.

Columella rather stout, upper termination rounded and elliptical in cross-section.

Locality.---Antigua, West Indies.

Geologic horizon.---Upper Oligocene.

Types.---United States National Museum (J. W. Spencer, Collector). R. T. Hill also collected specimens of this species in Antigua and Duncan's specimens are in the Geological Society of London.



*Astrocoenia barbadensis* sp. nov.

Pl. fig.

1902. *Astrocoenia* sp. Vaughan, Quart. Jour. Geol. Soc. London,  
Vol. LVIII, p. 358.

Corallum forming thick branches which are elliptical in cross-section. The type specimen possesses the following dimensions: length, 77 mm.; greater diameter of larger end, 29 mm., lesser, 19 mm.; greater diameter of smaller end, 22.5 mm., lesser, 16 mm.

Corallites polygonal, separated by walls which usually are acute along the upper edge and are thicker below. In rare cases apparently the wall may be 1 mm. in thickness. When the wall is not merely an acute ridge, short costae and a few granulations are present. The diameter of the corallites is from 1.5 to 2 mm. Calices excavated but not very deep.

Septa, moderately thick, sixteen in number, of which eight extend to the columella and eight are short. The outer ends are



not prominent. The margins are dentate, the dentations almost entirely destroyed in the type specimen.

Endothecal dissepiments present, thick and tabuliform.

Columella not very strong, and not very prominent.

Locality.---~~Near the Cathedral, Bridgetown, Barbados~~ (J. W.

~~Spenceer, Collector); Island of Antigua (R. T. Hill, Collector).~~

Geologic horizon.---

Type.---United States National Museum.



*Astrocoenia d'achiardii* Duncan.

Pl. fig.

1873. *Astrocoenia d'achiardii*, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIX, p. 554, plate 20, figs. 7, 7a
1899. *Astrocoenia d'achiardii*, Vaughan, Bull. Mus. Comp. Zool.  
Vol. XXXIV, p. 229.

Original description:

"The corallum is ramosc; and the smaller branches end suddenly with rounded tips. The whole is covered with crowded irregular calices, separated by thin and sharp walls, without ornamentation. The calices are deep, often quadrangular or pentagonal; and the styleid columella is situated deeply, and is usually small.

The septa are well developed. There are eight large ones, which reach the columella, and eight smaller, which project more or less, and are of different lengths in different calices, but which do not reach the axis.



In some large calices there are 32 septa; but these are very rare.

Gemmation occurs between the calices; and 16 septa exist very early.

Length of largest calices (rare) 1/4 inch. Usual length 3/20 inch. Branches from 1/4 inch to 1 1/2 inch in thickness.

In the collections of Mr. P. R. Cleve and of the University of Upsala.

Loc. The limestones of St. Bartholomew's, West Indies. "



*Astrocoenia duerdeni* Vaughan.

Pl. , figs. .

1865. *Stylocoenia emarciata*, Duncan, Quar. Jour. Geol. Soc.

Lond., vol. xxi, p. 7, 8, 13.

1867. *Stylocoenia emarciata*, Duncan, Quar. Jour. Geol. Soc.

Lond., vol. xxiv, p. 23.

1873. *Stylocoenia emarciata*, Duncan, Quar. Jour. Geol. Soc.

Lond., vol. xxix, p. 553.

1899. *Stylocoenia emarciata*, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 229.

1899. *Stylocoenia duerdeni*, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 235, pl. xxxvii, figs.

1-4.

Non.

1816. *Astrea emarciata*, Lamarck, Hist. Nat. Anim. s. Vert., t.

11, p. 266.

1857. *Stylocoenia emarciata*, Milne Edwards & Haime, Hist. nat.

Corall., t. II, p. 251.



Original description:

"Form of corallum, a convex mass; type specimen, 28 mm. in diameter on the base and 24 mm. high. The specimen is broken off from a larger piece, as Fig. 2, Plate XXXVII shows; therefore the above measurements do not represent the original size of the corallum. Calices shallow, hexagonal, subequal in size, 1.5 mm. to 2 mm. in diameter, close together, separated by a simple wall which is from a quarter to a half millimeter thick; often there are thickenings at the corners of the calices, and remnants of what appear to have been pillars. Septa sixteen, eight large, which fuse to the columella, and eight small shorter ones. Dissepiments present, apparently numerous, very thin, in places may be close together, .5 mm. apart. The columella is styliform.

Locality. District of St. Mary, Parish of St. Mary, Point Haldane (Institute of Jamaica); Port Maria (Geological Society of London).



Type. Collection of Institute of Jamaica.

The specimen that has come under my observation does not permit a more detailed description. The description and figures seem sufficient to make the species recognizable. This is undoubtedly the same as Duncan's Stylecoenia emarginata, as a comparison of the above description with the notes already given on his original specimen will show. The Stylecoenia cuerdeni seems to me distinct from Stylecoenia emarginata, both from the descriptions of the latter and after a comparison with specimens of the latter in the U. S. National Museum. The calices of emarginata are much larger, the maximum diameter being 3 mm. The usual diameter is 2.5 mm. or a little more, while in cuerdeni the usual diameter is between 1.5 and 2 mm., with 2 mm. as a maximum. This makes a difference in size of almost a millimeter. Although the specimen of cuerdeni is worn, in places the surface does not appear to have lost much from attrition, so one can determine the depth of the calices. They are much shallower than in emarginata.



Description of Duncan's Stylocoenia emarciata from the  
Island of St. Bartholomew:

Corallum small irregularly rounded above. Height, 30 mm.;  
diameter, 25 mm.

Calices polygonal, moderately deep; walls than at upper  
edge, below somewhat thicker, about .4 mm. Diameter of calices  
1.4 to 2 mm. Small projecting styles occur frequently, usually  
at the corners of the calices. They are considerably thicker  
than the wall, longitudinally striate, low, rounded above.

Septa, 16 in number, 8 principal and 8 rudimentary. The  
latter are very narrow. The septal margins are finely but very  
distinctly dentate. Interseptal loculi wide and open. Dissepiments  
present, rather thick.

Columella styliform, moderately large, prominent, the  
termination a slender pointed style.

Locality. Island of St. Bartholomew, West Indies, Capt.

A. Molander, Collector.



Geologic horizon: Oligocene, Limestone of St. Bartholomew.

Type: University of Upsala.

Remarks: There are six specimens in the University of Upsala collection that can be referred to this species with reasonable surety. They are all small masses differing in no noteworthy particular from the type specimen. There are eight other specimens that probably belong with it (pl. , fig. , represents one of them). The principal differences from the typical form are: the calices are shallower, the walls somewhat thicker, and the mural styles are not so well developed (or have been broken off). Because of the imperfect state of preservation of the material these specimens can not be positively identified.

Two specimens in the University of Upsala collection bear the label in Duncan's handwriting "Stylocoenia emarginata." Duncan undoubtedly erred in his determination as the septal margins are dentate thus removing the coral from the genus Stylocoenia, which



has entire septa. *Astrocoenia pumpellyi* Vaughan from Flint River, Georgia, has mural styles similar to those of *A. duerdeni*, the former, however, has twelve septa. As both species differed from typical *Astrocoenia* in the possession of these spines whether they should be placed in that genus or a new one created for them had to be considered. For the present at least, it seems inadvisable to give them a new generic designation, as the mural spines may not



*Astrocoenia incrustans* (Duncan)

Pl. , figs.

1873. *Stephanocoenia incrustans*, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 563, pl. xx,

fig. 6.

1899. *Stephanocoenia incrustans*, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 229.

Original description:

"The corallum is low in height, and incrusts rocky surfaces.

The corallites are united by their rather thick walls, and are parallel.

The calices are quadrangular or pentangular, and their margins are marked by the septa of the adjacent corallites.

The septa are subequal at the wall, and 16 in number; but only eight reach the small and deep styleid columella; the others project very slightly, and are moniliform on their free edge.



The pali are attached to the eight larger septa.

Height of corallum 1/10 inch (= 2.5 mm.). Breadth of calice 1/20 inch (= 1.25 mm.).

Loc. In the limestone of St. Bartholomew's."

Remarks: The following notes are based on the type specimen. It is a small thin fragment, 17.5 mm. long, 3 mm. wide, and 4 mm. thick.

The calices are moderately deep, polygonal, quite often elongated, the smaller ones measure .9 mm. in diameter, an elongated one is 1.2 mm. wide and 2 mm. long. The walls are thin, about .2 mm. thick; however, the upper edges of the septa are flattened and somewhat expanded. No mural styles.

Septa 16 in number, equal in thickness at the wall, thicker than the spaces between; 8 extend to the columella, the laminae thinner between the portions surrounding the columella and the outer ends. The other 8 septa are short. The margins are finely dentate. Distinct pali absent. Apparently dissepiments are present.



Columella styliform, rather prominent, compressed. This coral can not be referred to Stephanocoenia because there are no pali and the septal margins are dentate, instead of being entire. However, it exhibits all the characteristics of Astrocoenia. In the size of the calices, number of the septa and character of the septal margins, it resembles A. duerdeni, but differs from that species by the apparent absence of mural spines. Notwithstanding this, it is not impossible that the type specimen could be a portion of a corallum of A. duerdeni, the styles being absent from the area whence it was derived.

Locality: Island of St. Bartholomew, P. T. Cleve, collector.

Geologic horizon: Oligocene?

Type: University of Upsala.



*Antillia ? compressa* (Duncan).

Pl. , fig. .

1873. *Circophyllia compressa*, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 556, pl. xx, figs.

9, 9a, 9b.

1899. *Circophyllia compressa*, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, No. 1, p. 229.

The following is Duncan's original description:

"The corallum is tall, subturbinate, curved in the plane of the greatest axis of breadth, and is compressed laterally from the small peduncle to the deep calice.

"The calice is elliptical in shape; its margin is stout; the fossa is deep, and the longer septa reach a well-developed columnella with a flat top.

"The septa are of different and unequal sizes. There are five cycles of them in six systems; but the members of the fifth cycle are very small, and do not reach far from the margin.



The primary and secondary septa are equal; and the tertiaries are nearly as large; but all are rather small. There are 48 septa that reach the columella.

"The costa are distinct, and are alternately large and small; all are delicate, straight, and slightly prominent. Those of the fifth cycle are very distinct.

"The exotheca is well developed; and there are annular traces of a rudimentary epitheca.

Height of type 1 3/10 inch. Breadth of calice 9/10 inch.

Loc. St. Bartholomew's, West Indies."

Type. University of Upsala, P. T. Cleve, Collector.

Additional notes.---I have been able to study the type of this species, the only specimen positively referable to it that I have seen. The specimen is in poor condition and does not permit ascertaining many details of structure that must be known before it can be positively referred to the genus to which it belongs.



The form is as Duncan described it. The greater diameter of the calice is 24.5 mm.; lesser, 17 mm.; height 37 mm.

The wall is rather stout, distinctly but only moderately strongly costate. Costae alternately larger and smaller, between 90 and 96 in number, their edges worn, but appear to have been rather sharp. Apparently, but not positively, vestiges of encircling epitheca, are present.

The septa agree with Duncan's description.

Columella well developed, composed of an interfusing network.

There are low opposed ridges on the septal faces, and as such a character is usually (or always) an accompaniment of dentate septal margins, it is supposed that the margins are dentate in this coral.

Because of the apparent presence of an epithecal envelope, and rather finely dentate septal margins and as there is a well developed spongy columella the species is provisionally referred to the genus Antillia.



*Antillia? clevci* Duncan.

Pl. , fig.

1873. *Circophyllia clevci*, Duncan, Quart. Jour. Geol. Soc. Lond.,  
vol. xxix, p. 556, pl. xxi, figs. 10, 10a, 10b.

1899. *Circophyllia clevci*, Vaughan, Bull. Mus. Comp. Zool. vol.  
xxxiv, No. 1, p. 229.

Duncan described this species as follows:

"The corallum is turbinate, slightly or decidedly com-  
pressed superiorly, and has a small mamilliform peduncle.

The calice is elliptical, open, moderately deep; and its  
margins are rarely incurved.

The septa are in six systems; and there are five cycles of  
them. The septa of the highest cycles are small; and those of  
the other cycles are large, long, and reach the columella, which  
is distinct and flat.

The wall is thick. The costae are subequal superiorly, and  
are wide apart everywhere.



The exotheca is slightly developed.

"Height of corallum 1 1/2 inches. Breadth of calice 2 inches. This relative length and breadth of 3 to 4 is very general in specimens.

Loc. St. Bartholomew's, West Indies.

x x x x x x

"Most of the specimens, which are numerous, have been rolled; some are broken; and others are partly imbedded in volcanic debris. All indicate, however, that they had a vigorous nutrition; for they are large forms, and possess numerous septa."

Types.---Collection of the University of Upsala. P. T. Cleve, Collector.

Additional remarks.---The authorities of the University of Upsala have lent me the types of Duncan's Circophyllia clevei and there are other specimens in the same collection.

The types consist of three specimens, a different specimen serving for each of the three figures given by Duncan. The one

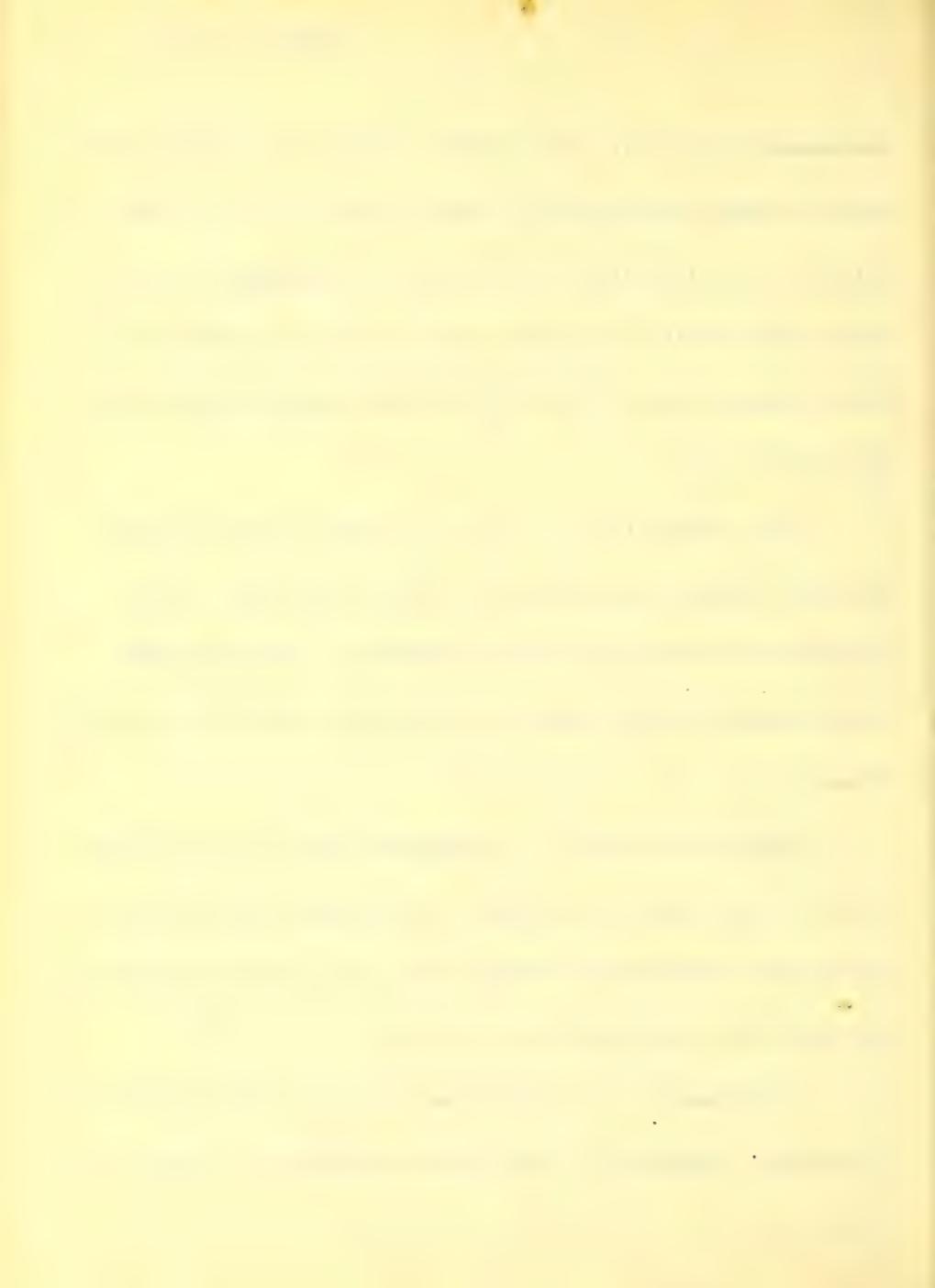


represented by pl. xxi, fig. 10, had a piece of matrix attached to one side obscuring much of the outer surface. I have removed the matrix and shall consider this specimen the holotype. The original of fig. 10a is a much worn specimen that may belong to another species; that of fig. 10b is probably specifically identical with the type.

The holotype (pl. , fig. ) is turbinate in shape, somewhat curved, and attached by a rather small base. The transverse outline is irregularly circular. Greater transverse diameter 30 mm.; lesser, about 29 mm.; height of corallum, 35 mm.

Wall with vestiges of epitheca overlying the ends of the costae. The costae are distinct, rather acute, distant, frequently with dissepiiments between them. The number around the upper portion of the corallum is about 60.

As the calice of this specimen is filled with hard matrix, I selected a specimen that from external appearance belongs to



the same species and had it sectioned. This specimen has 56 septa, of these about twenty extend to the columella. There is no definite cyclical arrangement. This section is represented by pl. , fig. . Thick endothecal dissepiments are present but scanty. Because of change due to the fossilization and the generally poor state of preservation of the specimen, it has not been possible to determine the character of the septal or the lateral ornamentation of the septa.

The columella is fairly well developed, consists of a number of processes that fuse with one another and to the inner ends of the larger septa.

The genus can not be positively determined. Those characters that can be discovered point to its being either Antillia or Syzygophyllia. These two genera are distinguished by difference in the dentation of the septal margins. As these characters are obliterated in the species under discussion, it is not possible to refer it to either one of these genera. I have therefore placed it provisionally under Antillia.



*Antillia anguillensis*, sp. nov.

Pl. figs.

Corallum elongate, tall, compressed. Greater diameter, 42.5 mm., lesser, 32 mm.; height, 79+ mm. The tip of the base is broken. The young part of the corallum rapidly increases in diameter, but there is no or very little increase throughout the upper 67 mm., in fact there are some constrictions.

Covering the costae is an incomplete, glossy, minutely wrinkled epitheca. The wall cannot be definitely seen in the type specimen, but in another one, it is at its upper edge thin. The costae are rather low, equal or alternating in size, edges usually acute and headed, intercostal spaces usually wider than the costae.

Septa thin, numerous, about 100, five complete cycles with a few members of the sixth. The number cannot be definitely determined from type without a transverse section, but from another specimen every third one seems to reach the columella.



The septal margins are finely and rather sharply dentate, the dentations terminating in septal ridges. Exotheca and endotheca abundant.

Calice moderately deep. Columella small, trabecular in character.

Locality: Island of Anguilla, West Indies, P. T. Cleve,  
Collector.

Geologic horizon: Upper Oligocene.

Type: University of Upsala.

Remarks: Besides the type there are two other specimens that probably belong to this species. They, however, are both damaged and the identification is not positive.

This species is very closely related to the elongated specimens Antillia lonsdaleia Duncan. The former is taller and its costae and septa in general are thinner. The number of septa and the columella of both seem the same.



*Cladocora anguillensis*, sp. nov.

Pl.      figs.

Corallum consists of elongate corallites, reproducing by lateral gemmation, the buds sometimes opposite. The type consists of a portion of a broken colony, imbedded in a yellow argillaceous limestone, and a separate fragment. In height the corallum certainly exceeded 55 mm. The branches are not crowded, one single corallite which has not budded is 18 mm. long. In cross-section the corallites are elliptical or subcircular. The fully grown subcircular ones are about 6.5 mm. in diameter; the elliptical ones 9.5 by 7 mm. in diameter. The corallites are quite large, somewhat larger than in C. jessai-caensis Vaughan but smaller than C. recrescens Lonsdale. Costae distinct but not prominent, corresponding to all septa, subequal in size, alternating or every fourth one slightly larger. Their relative width is variable, they may be narrow, with wider intercostal furrows, or may be rather thick.



Septa between 36 and 40, apparently as a rule every fourth one reaches the columella; they are somewhat thickened at the wall but the inner portions are thin. Columella lax.

Locality: Island of Anguilla, West Indies, P. T. Cleve,  
Collector.

Geologic horizon: Upper Oligocene.  
Type: University of Upsala.



Family ORBICELLIDAE Vaughan

- 1901.- Orbicellidae Vaughan. Stony corals of the Porto Rican waters,  
U. S. Fish Commission Bull. for 1900, vol. 2, p. 300.
- 1902.- Orbicellidae Verrill, Trans. Com. Acad. Sci., vol. XI, p. 93,  
Type genus, Orbicella Dana.

Vaughan's original characterization of the family: "Calcareous tissues normally imperforate, except in the columellar region. Corallites grouped into rounded, gibbose, or digitiform masses. Septal margins dentate. Reproduction normally by gemmation between the corallites, occasionally abnormal reproduction by fission."

No differential characters given by which the family can be separated from the Astrocoeniidae. Compare diagnoses of the two families.

List of Orbicellan corals in manuscript.

*O. annularis* (Ell. & Sol.)

*M. favescens* E. & S.

*H. acrepora* D. & M.

*H. lamarckii* D. & M.

*Phyllocoenia sculpta* var. *tegula* Duncan

*Cyphastraea costata* Duncan

*Astraea barbadensis* Duncan

*Echinopora frankai* Gregory

*O. hispidula* Verrill

*O. limbata* (Duncan)

*Phyllocoenia limbata* Duncan

*Pleisiastrea ramea* Duncan



*O. albissima* (Duncan)  
*O. cellulosaa* (Duncan)  
*O. ? megalaxona* (Duncan)  
*O. tenuis* (Duncan)  
*O. cavernosa* (Linn.)

*M. astracites* Pallas

*M. radiata* Ell. & Sol.

*Astrea argus* Lam.

*Heliastraea conferta* M. Edw. & H.

*Astraea endothecata* Duncan

*Astrea cylindrica* Duncan

*Astrea antillensis* Duncan

*A. radiata* var. *intermedia* Duncan

*A. brevis* Duncan

*Heliastraea aperta* Verrill

varieties recognized:

var. *tampaensis*

*silicisensis*

*bainbrigensis*

*anguillensis*

*O. antillarum* (Duncan)

*O. insignis* (Duncan)

*O. gabbi* Vaughan

*Brachiphyllia eckeli* Duncan

*irregularis* Duncan



*Cyphastrea hyades* (Dana)

*caribaea* (Duch. & Mich.)

*Diplotheccastraea moniter* Duncan

*Septastrea marylandica* (Conrad)

*crassa* (Holmes)



*Orbicella annularis* (Ell. & Sol.)

Prof. J. Graham Kerr, of the University of Glasgow, has kindly sent me photographs of the type of this species, which is preserved in the Hunterian Museum at that institution, and I have based the following description on them.

The corallum is head-shaped, with a greater diameter of 107 mm. and a lesser of 86.

The calices are circular, 2 mm. in diameter, margins slightly elevated, joined by equal costae, distance apart usually about 1 mm., occasionally 2.

Septa 24 in number, alternately larger and smaller; the large, rather thick and reaching the columella; the intermediate ones, short, their inner ends free.

Columella spongy, well developed, its diameter about one-third that of the calice.

A comparison of the photographs with specimens shows that the traditional *Orbicella annularis* of the Caribbean and Gulf regions is correctly identified.

There are in the collection of the United States National Museum a number of specimens that are almost duplicates of the type specimen, except they are not somewhat worn as is the type. These specimens form the basis of the succeeding description.

The corallum forms rounded masses rising above a rather large, firmly attached base, which is, however, less in diameter than the maximum diameter of the corallum. Frequently there is a projecting or incrusting edge whose lower surface is covered by epitheca. The



upper surface may be uniformly rounded, undulated, or lobed. The size, of courses, is variable; the masses may be several feet in diameter.

The calices are circular, or slightly deformed. Their diameter, measured between thecal summits is from 2 to 2.5 mm. In depressions of the surface they may be smaller, about 1.5 mm., but these are abnormal. Their edges are from .5 to almost 2 mm. apart, about 1 mm. is probably an average. The calicular edges are slightly elevated. The intercorallite areas are costate: Costae corresponding to all septa subequal or alternating in size, those of adjoining calices meeting, edges dentate, thicker than the width of the intercostal spaces and moderately elevated.

Septa in three complete cycles, primaries and secondaries equal, rather stout, extending to the columella and fusing to it; tertiaries shorter, about half the length of the primaries, somewhat thinner, inner edges free. Margins of the primaries and secondaries decidedly exsert; their inner edges fall perpendicularly to the bottom of the calicular fossa, and bear just above the columella one or two prominent teeth, with a few smaller teeth above; the septal arch is either very gentle, obtuse, or it may be truncate; its dentations fine, the outer margins steep, but more inclined than the inner, dentations relatively coarse. Septal faces finely granulate; in longitudinal sections, the inner edges are lacerate, the last cycle with perforations.

Endothecal dissepsiments delicate, thin, nearly horizontal, slightly inclined downward from the corallite walls. In this series of specimens the corallite walls are thick and close together, those of adjacent corallites sometimes being solidly fused together; usually, however, there is some exotheca, consisting of stout, subhorizontal dissepsiments.



Columella well developed, formed by interlacing processes from the inner edges of the septa, diameter from one-third to one-half that of the calice, its upper surface about 5 mm. below the thecal margin.

These specimens, it should be repeated, are typical, and except in size and to a certain extent in the configuration of the surface show almost no variation. They come from the following localities: Dry Tortugas, Florida, Dr. Edward Palmer, collector, 8 specimens; east end of Hog Island, Bahamas, B. A. Bean, collector, 1 specimen. There are several other specimens, bearing the indefinite label "West Indies" or having no locality stated. These localities indicate that the species in its typical form is of rather general occurrence in the coral reef areas around the Caribbean Sea and Gulf of Mexico.

The recent specimens in the United States National Museum show at least four types of variation from the typical form.

Variation No. 1. This variation is, I believe, only a growth form. It, in its structural features, is the same as the typical form, except the septa near the growth edge are less exsert and the exotheca appears to be absolutely solid. The corallum is an obtuse, compressed column, with an undulated surface. Greater diameter of the base, 62 mm.; lesser 52 mm.; height 72 mm.

Locality: Dry Tortugas, Florida.

Variation No. 2. The general growth form is similar to that of typical specimens, except the surface is thrown into gibbosities of irregular shape and size; these are often about a centimeter in height and several centimeters in diameter. The calices are larger than in the typical specimens, often measuring 3, occasionally 4 millimeters in diameter, i.e., between thecal summits. The thecal edges are slightly elevated; the mar-



gins of the primaries and secondaries decidedly exsert, not infrequently standing 2 mm. above the intercorallite furrow. The three characters here mentioned are the distinguishing ones of this variation, viz: gibbosities on the surface; 2, larger calices; 3, more exsert septa.

Localities: Dry Tortugas, Florida, Dr. Edward Palmer, collector, 1 specimen; east end of Hog Island, Bahamas, B. A. Bean, collector, 1 specimen; and two other specimens without locality labels.

Variation No. 3 is represented by a single specimen. The corallum is discoid, lower surface flat, upper convex, some irregularities. Greater diameter, 22.7 cm., lesser, 19.2 cm.; thickness in the center about 5 cm., on the edge, 3 cm.

Calices with elevated margins, and crowded together, the different corallite walls almost contiguous; margins of primary and secondary septa decidedly exsert. Diameter of calices about 2.75 mm.

The distinguishing characters of this variation are (1) its discoid form, (2) its crowded calices, (3) its decidedly exsert septal margins.

Locality: Fort Taylor, Key West, Florida.

Variation No. 4 is represented by the specimens that I described from <sup>1/</sup> Mayaguez, Porto Rico, in my "Stony corals of the Porto Rican waters."

1/ Bull. U. S. Fish Commission for 1900, vol. II, p. 301, Pls. VI, VII, 1901.

The following description is based on them:

The corallum forms ascending masses; the largest specimen is about 20 cm. tall; diameter above flared-out base about 18.5 cm. The bases of the specimens are considerably produced as wide, from edge, and supported by epitheca.



Calices with very slightly or only moderately elevated margins, diameter measured between thecal summits, from 3.25 to 4 mm.; rather shallow; distance apart, from a thin dividing edge to 2.5 mm.; about 1.5 mm. is probably the average. Thin costae moderately prominent, subequal, or alternating in size, correspond to all septa; those from one calice extend across the intercorallite spaces and meet those from the adjacent calices.

Septa thin, 24 to 28 in number, one-half of them extend from the wall to the columella, and have decidedly exsert margins; the other half are not so tall and are short, their inner ends free.

Endotheca and exotheca as in the typical specimens, except they are more delicate.

The specimens differ from typical ones by their much lighter texture, which of course is determined by their thinner skeletal structures, the wide, flaring, free edges of the base, and the larger calices. The calices overlap in size those of variation No. 2, otherwise I should consider the specimens as representing a distinct species.

Variation No. 3. Orbicella hispidula Verrill, Trans. Conn. Acad. Sci., vol. XI, p. 100, Pl. XV, figs. 3, 3a, 3b. The following is the original description:



"Coral an incrusting mass over 125 mm. across, and from 5 to 20 mm. thick. The texture is rather solid and heavy, there being much solid exotheca between the calicles, which are rather far apart, the interspaces being mostly equal to, and often exceeding, their diameter.

"The calicles are round, regularly stellate, a little prominent, with swollen, sloping, costate rims, much as in those of O. annularis, which they resemble in size, though distinctly larger. The septa are in three very regular cycles: the twelve principal ones are wide, nearly equal, all reaching the rather large columella; their edges are perpendicular and finely, sharply serrate, with slender, rough teeth, which extend also over their prominent, obtuse, or subtruncate summits, giving them a rough appearance under a lens; their surfaces are also rough or hispid with numerous conical grains. The septa of the third cycle are narrow, straight, and usually reach about half-way to the columella.

"The costae are thick, not very high, meeting or incrusting between the calicles, and covered with a single row of small, slender, rough spinules. The columella is well developed, formed of contorted trabecular processes, and often having a small pit in the center and a few erect spinules, similar to the slender, rough, paliform teeth that often (but not regularly) stand at the base of some of the 12 larger septa.

"In sections the walls are very thick and nearly solid. The endothecal dissepiments are small, thin, irregularly convex or flat above. The calicles are not filled up below, or only slightly encroached upon, by a deposit between some of the septa. Diameter of the calicles 3" to 3.5 mm.; distance between them mostly 2 to 4 mm., often more.

"Florida Reefs (Maj. E. B. Hunt), Yale Museum, No. 98. Near Nassau, N. P. (coll. R. P. Whitfield), Amer. Mus., New York.

"This has the general appearance of O. annularis, but with calicles larger than usual and decidedly farther apart. The walls and exotheca are much thicker and more solid, and the endothecal cells are fewer and less regular. The sharply spinulose and hispid septa and costae are also characteristic. The exothecal deposits are nearly as solid as in Oculina.

A Nassau specimen, in the American Museum, is an irregular, rounded mass, about 5 inches in diameter, and 3 to 4 thick, with a lobulated surface. The coral is heavy and solid; the surface of the coenenchyma is spinulose; the costae well developed. The calicles are more variable in size than in the type, in some places being one-half smaller and closely crowded. Coll. R. P. Whitfield."



A specimen from Port Castries, Santa Lucia, shows a variation worthy of note. In all of the variations so far described, the primary and secondary septa are constantly equal, uniformly reaching the columella. In the Santa Lucia specimen a secondary septum is sometimes shorter than and thinner than a primary; besides in some calices there are as many as 30 septa. This specimen is of importance for comparison with Phyllocoenia sculpta var. tegula Duncan and Echinopora franksi Gregory.

These remarks cover the variation of the recent specimens that I have actually been able to study. Pourtales, Verrill, and Duerden, however, have added other observations.

Pourtales says of the species: "The same remarks about variation, given under the head of O. cavernosa, can be applied to this species; there are very fine examples in the Museum of the great variation of form of the calicles in the same specimen.

"It is very common in Florida on the reef and in the channels, and forms large hemispherical masses nearly up to low-water mark. The central and highest part often dies out from being left uncovered at very low tide and the mass then assumes an annular form through the decay of the dead part."  
1/

1/ Ill. Cat., Mus. Comp. Zool. IV, p. 72, 1871.

Verrill writes: "It shows considerable variation in the size of the calicles; in the extent to which they are crowded together; in the prominence of their borders above the intervening exotheca; in the prominence of the septa above the walls; and in the extent to which the small septa of the third cycle are developed. But yet these variations, so far as



I have seen, never go so far as to render difficult the recognition of the species unless the specimens are badly worn.

\* \* \* \* \*

"When well grown it forms hemispherical or spheroidal masses, up to 5 feet or more in diameter. But it also grows in irregular, incrusting plates, and sometimes in nodose or lobulate masses, or even in branched forms."<sup>1/</sup>

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1/ Trans. Conn. Acad. Sci., vol. XI, pp. 95, 96, 1902.

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Duerden, in describing specimens from Jamaica, says: "The species occurs on coral areas in small or large, fixed, nearly spheroidal masses; also as an encrustation occupying areas several feet across. Small isolated colonies are sometimes conical. In places it is an important constituent of the reefs."<sup>2/</sup>

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2/ West Indian Madreporarian Polyps, Mem. Nat. Acad. Sci., vol. VIII, p. 564, 1903.

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The foregoing descriptions and notes will indicate that we have considerable information on the variation of the species, but excepting one note by Pourtales, we have no data relating to the effect of environment on variation.

#### Variation of Fossil Specimens.

There are specimens, particularly those of known Pleistocene age, similar to the typical form of the species, except there may be variations in the size of the calices; those of a specimen from Fort Nassau, Curacao, range from 3 to 4.5 mm. in diameter, measured between thecal



summits; those of another specimen from Westpunt, Curacao, are from 2.5 to 3 mm. in diameter. The former possesses the largest calices of any specimen of the species that I have seen.

The variations not included in the preceding remarks may be divided into two classes, dependent upon growth, viz: a. explanate or incrusting; b. columnar.

A. Growth from explanate or incrusting.

A. Echinopora franksi Gregory. Quart. Jour. Geol. Soc. London, vol. LI, p. 274, Pl. XI, figs. 2a, 2b, 1895. Gregory was mistaken in referring the specimens to the genus Echinopora. The following is the original description:

"Diagnosis. The coral has a broad base; from this pass outward short, thick, rapidly tapering expansions.

"Corallites long: often an inch in length. Their distance one from the other varies from half their diameter to the whole.

"Septa strongly dentate; inner teeth paliform, in three cycles. Those of the first cycle always unite to the columella; those of the second cycle often do so, but may join the primary septa; those of the third cycle are much smaller and independent, but a few may unite with the septa of the other orders.

"Columella of very loose tissue; half the diameter of the corallite. Endotheca scanty. Coenenchyma thinner than in other species of the genus. Echinulations of the surface coarse. Epitheca thick and well developed.

"Dimensions. Diameter of an average corallite, 3 mm.; height of corallite varies from 10 to 25 mm.; thickness of wall varies from  $1\frac{1}{2}$  to 3 mm.



"Distribution. Recent: West Indies, Fossil: Barbados: Lowland Reefs, near Bridgetown."

Cotypes: British Museum (Natural History); a piece of one of the cotypes in the United States National Museum.

A comparison of this description with the notes on the variation of Orbicella annularis will show that it presents no important difference from variations of the species already recorded. Its growth form is explanate, the exotheca is solid, and the secondary septa often, but not always, reach the columella.

A. "Phyllocoenia sculpta var. tegula" Duncan, Quart. Jour. Geol. Soc. London, vol. XIX, p. 432, 1863. As I do not find Duncan's description of this coral satisfactory, and as the authorities of the Geological Society of London have kindly sent one of the original specimens to the United States National Museum, I submit the following description: Corallum, a rather thick folium; the specimen here described is unfortunately broken on all its edges, its original dimensions are therefore unknown. Its present length is 62 mm.; width 40 mm.; greatest thickness, 15.5 mm.; thickness near outer edge 5.5 mm. Base invested with a coarsely wrinkled epitheca.

The calices have margins on the same level as the flat exothecal surfaces or very slightly raised; in form they are circular or are somewhat deformed. Diameter from about 2 mm. to 3.25 by 2.5 mm.; distance apart, from 1 to 3 mm. Intercorallite areas with cestae, beaded on the edges, equal or alternating in size, corresponding to all septa, those of one calice meeting those of the adjoining calices.



Septa usually in three complete cycles, primaries and secondaries larger, and usually thicker, than the tertiaries. All the primaries and most of the secondaries reach the columella.

Columella trabecular.

Locality: "Nivaje shale," Santo Domingo, t. Duncan.

A careful comparison of this specimen with a specimen of Gregory Echinopora franksi has not revealed to me any tangible difference between the two. It might be added that the coral is not a Phyllocoenia.

B. Growth from columnar.

These are the specimens referred to in my paper "Some fossil corals from the elevated reefs of Curac<sup>oy</sup>, Aruba, and Bonaire,"<sup>1/</sup> obtained by

1/ Samml. Geolog. Reichs. Mus. Leiden, Ser. II, Bd. II, Heft I, p. 26.

Mr. v. Koolwijk at Westpunt, Curac<sup>oy</sup>. Three of the specimens are in the United States National Museum, and they form the basis of the following description:

The corallum forms ascending, compressed, obtuse columns.

Specimen	Greater diameter of base	Lesser diameter of base	Height	Remarks
No. 1	37.5 mm.	25 mm.	60 mm.	Bifurcation 32 mm. above base.
2	30+	23	71	Constricted above base; gradually enlarging above the constriction.
3	27.5	21	91	



Calices 2.5 to 3.5 mm. in diameter; from less than 1 mm. to 2 mm. apart. The upper margin is usually not elevated, while the lower one is, thus tilting the calicular crifices. The maximum length of the lower limit of the calice is about 3 mm. Subequal, relatively thick, dentate costae correspond to all septa.

The usual number of septa is three complete cycles, primaries and secondaries subequal and reaching the columella; tertiaries short, inner edges free. The septa present only one noteworthy difference from what is usual in O. annularis, that is, the margins of the primaries and secondaries are less exert.

Columella not very large, loose, trabecular.

The three salient characteristics of this variation are, (1), its growth form; (2), the distally tilted calices; (3), the lower margins of the primary and secondary septa.

Geologic horizon: Pleistocene.



A number of other names need to be considered in greater or less detail.

1/ Gregory applied the name Orbicella acropora (Linnaeus) to this

1/ Quart. Jour. Geol. Soc. London, vol. LI, p. 272, 1895.

species. He accepted the determination of the species by Milne Ed-

wards & Haime, who separated it from O. annularis by its having no septa

2/ Hist. Nat. Corall. t. II, p. , 1857.

corresponding to the last cycle of costae. Gregory showed that occasionally in typical specimens of O. annularis the last cycle of septa may be absent while the costae are present, thus breaking down the character used by Milne Edwards & Haime to differentiate the species. I accepted Gregory's conclusion, and followed him in my paper on "Some fossil corals from the elevated reefs of Curaçao, Aruba, and Bonaire," and subsequent papers. Prof. Verrill, in his "Variations and nomenclature of Bermudian, West Indian, and Brazilian reef corals," declares that

3/ Trans. Conn. Acad. Sci., vol. XI, p. 94, 1902.

Madrepora acropora Linnaeus "is utterly undeterminable" and takes the next younger name, annularis Ellis and Solander, for the species. Subsequent study convinced me that Prof. Verrill was right, and I published my change of opinion in a little paper on "Some recent changes in the nomenclature of West Indian corals." Therefore, I now believe

4/ Biol. Soc. Washington Proc., vol. XV, p. 56, 1902.

that Madrepora acropora Linnaeus should be considered as undeterminable,



and that the name should be dropped from coral nomenclature.

The type specimen of Madrepora faveolata Ellis & Solander is preserved in the Hunterian Museum of the University of Glasgow, where I have seen it, and Prof. Kerr has kindly sent me a photograph. It is a worn specimen, considerably infiltrated with carbonate of lime, and is probably the same as Orbicella annularis.

Astrea (Orbicella) stellulata Dana has been carefully redescribed by Prof. Verrill from Dana's types, which are preserved in the Yale University Museum. The following is his description:

1/ "They are beach-worn specimens of a true Orbicella, more or less infiltrated with calcium carbonate, to which the unusual solidity of the walls and exotheca, in some parts, as seen in sections figured by Dana, seem to be partly due. In other parts the structure is nearly as in O. annularis, to which it probably belongs, though there are differences in the sections not due to infiltration. Its septal ar-

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1/ Conn. Acad. Sci. Trans., vol. XI, p. 96, Pl. XV, fig. 2, 1902.

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rangement is the same as in ordinary specimens of the latter, those of the third cycle being distinct, but narrow and thin. The borders of the calicles seem to have been but little raised, and the septa rather thinner than usual, and not much exert, but the poor condition of the specimens renders these characters rather uncertain.

"The calicles are rather smaller (2 to 2.5 mm. in diameter) than is usual in O. annularis. The thin septa are in three regular cycles; those of the third cycle are very thin and reach only one-fourth or one-third to the columella, which is well developed. The septa are a little thickened at the wall; their faces are only slightly granulated. There are a few, irregular small teeth on their inner edges where best preserved; upper ends are all worn off; some have a pali-form teeth at the base. The costae are well developed, inosculating, with irregular exothecal dissepiments between them, as in O. annularis. But in some vertical sections the walls appear as narrow, solid structures (where unaltered); in the sections the columella region is loosely filled with stout ascending trabeculae; the endotheca consists of small, very thin, nearly horizontal dissepiments, inclining downward a little, and often in two series. No. 4266.

"Their origin is uncertain, but it appears to be West Indian. They are in the same beach-worn state as several other types of West Indian corals studied by Prof. Dana. Apparently most West Indian corals, in good condition, were scarce in American museums at the time when he wrote his great work.



"It appears to be a small or somewhat dwarfed variety of O. annularis. I have seen fresh specimens of a similar variety from the Florida reefs.

"This may well be identical with M. stellulata Ellis and Sol., but the latter cannot be determined with any certainty from the figure, which represents a badly worn specimen. Its calices, as figured, are mostly even smaller than in Dana's type, and somewhat unequal in size; the walls appear to be as solid as in the latter; the calices project slightly as in annularis; 12 to 15 septa are figured, all perfect; columella is as in annularis. There is much more reason for calling this a variety of O. annularis than there is for identifying it with Solenastraea hyades, as Gregory has done. There is no evidence that it is a Solenastraea."

Fortunately Dana's Orbicella stellulata is a synonym of O. annularis and is not even of varietal importance. Prof. Verrill says "This may well be identical with M. stellulata Ellis and Sol.," an opinion from which I wish emphatically to dissent. The figures of Ellis and Solander are of a Solenastraea, (Pl. LIII, figs. 3, 4,); the costae do not continue from a calice to those of adjacent calices, and the exotheca, as is shown by the side of figure 3, is typical of Solenastraea. Furthermore, in the description of the species it is stated, "interstitiis planiusculis scabriusculis," the intercorallite areas are not "radiate" as in annularis. The Heliastera stellulata of Milne, Edwards & Haime is not the Madrspora stellulata Ellis & Solander; it is probably the same as Orbicella annularis. The identification of the Ellis & Solander coral will be discussed subsequently.

There is much doubt about the Cyphastraea obliqua Duchassing and Michelotte. The following is the original description:

"Espèce arrondie, avec des étoiles arrondies et à bord un peu élevé: côtes rares presque confluentes: les intervalles d'une à l'autre étoile sont garnies de granulations: la columella est grande et papilleuse.



"La Cyphastrea oblita a les bords moins eleves, et les cloisons plus debordantes que celles de la Chyp. microphthalmia qui sont aussi garnies d'une petite dent subpaliforme qui 'nangue dans la Chyp. oblita.

"St. Thomas."

I found in the Museum of Natural History at Turin a specimen labeled "Cyphastrea oblita." It is a specimen of Orbicella annularis. Another specimen bearing the same label, seen in the Museum d'Histoire Naturelle at Paris, is a Solenestrea. The latter is a rounded head with a greater diameter of about 130 mm. The calices range in diameter from 2 to 3 mm.; distance apart from somewhat less to slightly more than 1 mm., occasionally 2 mm. Margins of the calices marked by a slightly raised rim. Costae insignificant, occasionally extending from one calice to the next. Septa in three complete cycles, primaries and secondaries reaching the columella; tertiaries shorter, with inner edges free, i.e., not fused to the sides of a lower cycle. Pali variable in development: in some calices they are large, flattened above, before all septa except the last cycle; in others, several teeth indicate the position of a palus. Columella, lax and papillary. This specimen is the same as the Heliastrea abdita, Duch. & Mich.

The original description of Cyphastrea oblita is not adequate for identification: one of the specimens from the Duchassing & Michelotti collection is Orbicella annularis, the other the same as their own Heliastrea abdita, making it impossible to determine the type. It is therefore best to drop the name altogether.



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Heliastraea rotulae Duchassing & Micheletti is a growth form of O. annularis, judging by the description. I did not find the type in Turin.

The specimens determined by Duchassing and Micheletti as Heliastraea acropora (Linn.) and H. lamarckii M. Edw. & H. are, according to specimens bearing those names in the Museum of Natural History at Turin, referable to Orbicella annularis.

The type of Duncan's Cyphastraea costata from Barbada is preserved in the Geological Society of London and I studied it there. The specimen shows no noteworthy variation from the usual Orbicella annularis, except its calices are from 3 to 4 mm. in diameter, usually 3.5 mm. Another specimen, from Santo Domingo, labeled Cyphastraea costata, is a Solenastrea. The specimens determined by Gregory as O. costata were studied in the British Museum of Natural History; they are O. annularis.

Astraea barbadensis Duncan is a specimen of O. annularis from the Pleistocene reefs of Barbades.

Gregory refers Heliastraea altissima Duncan to the synonymy of this species, but I doubt the correctness of his conclusion and am treating it as valid.

Geologic distribution: Pleistocene, throughout the elevated reef areas of the West Indies.

Duncan has listed Astraea barbadensis, one of the synonyms of O. annularis, from the marl formation of Antigua, remarking that it is "greatly altered by fossilization; the calicular surface is sub-plane, and the calices are seen as prominent columnar casts." Should Duncan's identification be correct, O. annularis extends downward into the Oligocene.



*Orbicella limbata* (Duncan)

Plate , Figs.

1863. Phyllocoenia limbata Duncan, Quart. Jour. Geol. Soc. London,  
vol. xix, p. 433.
1864. Plesiastraea ramea Duncan, Quart. Jour. Geol. Soc. London,  
vol. xx, p. 39.
1866. Phyllocoenia limbata Duchassaing & Michelotti, Suppl. Mim.  
Corall. Antilles, p. 170.
1866. Plesiastraea ramea Duchassaing & Michelotti, Suppl. Mim.  
Corall. Antilles, p. 181.
1868. Phyllocoenia limbata Duncan, Quart. Jour. Geol. Soc. London  
vol. xxiv, p. 23.
1868. Plesiastraea ramea Duncan, Quart. Jour. Geol. Soc. London,  
vol. xxiv, p. 25.
1870. Phyllocoenia limbata Duchassaing, Rev. Zooph. et Spong.  
Antilles, p. 28.
1870. Plesiastraea ramea Duchassaing, Rev. Zooph. et. Spong.  
Antilles, p. 30.



*Orbicella limbata* (Duncan)

Original description:

"Corallum in the shape of *Styliina limbata*, Edwards & Haime.

Stem large and cylindrical. Corallites numerous, irregularly placed. Calices separated by much coenenchyma, circular and but slightly elevated. Costae covering much surface. Slightly dentate where they approach, and turning aside from those of other calices; they are not continuous, not very prominent, and slightly granular. Septa not projecting far inwards, laminae granular; their upper margin is neither incised nor dentate; in six systems of generally three cycles, though occasionally of four. Primary septa largest. Columella rudimentary. Endotheca abundant. Diameter of calice, with costae, 1/5 th inch.

"The deficient columella is the only point in which this species differs from *Madrepora limbata* Goldfuss, which has been determined by Milne-Edwards to be a *Styliina*.

"From the yellow shale of San Domingo. Coll. Geol. Soc."



Original description of Plesiastrea ramea Duncani:

"Corallum in gibbose masses or more or less cylindrical processes with irregular swellings. Calices distant, very slightly exsert, circular, and unequal in size. Septa thick at the wall, thin internally, unequal in size, according to the orders; firmly dentate above, but sparingly granular laterally. In six systems of three cycles, with occasionally an additional order in one half of a system. Pali very small. Columella lax, papillated, and small. Fossa moderately deep. Costae well developed, subequal, and marked by three or four dentate projections; they are evidently covered with a fine epitheca, which is not granular; where the epitheca is worn the costae are seen to be smaller, the tertiary being much smaller than the others; all project, however. Exotheca moderately developed and often becoming indurated. Endothecal dissements fragile, but horizontal and frequent. Height, some inches; diameter of branches 1 inch, more or less; diameter of corallites 4/30ths inch; distance between corallites about 1/10th inch.

"From the silt of the Sandstone plain, San Domingo. Coll. Geol. Soc."



I examined Duncan's types of Phyllocoenia limbata and Plesiastrea ramea in the Geological Society of London and made a note that the latter, except its septa are broken down and the calices have a hollowed-out appearance, is the same as the former.

In my "Some fossil corals from the elevated reefs of Curacao, Aruba and Bonaire" and my "Stony corals of the Porto Rican waters," I placed these two names of Duncan in the synonymy of Orbicella acropora (= O. annularis), considering them a growth form similar to the variation described from Westpunt, Curacao. More detailed studies, subsequently made, have led me to think that I was probably mistaken in that course. This coral is very similar to O. annularis. However, there appear to be two constant differences, viz: the primary septa within the calices are uniformly thicker and usually longer than the secondaries (this lesser development of the secondaries is not occasional as in O. annularis but constant) and small, but distinctly developed, pali occur before the primary and secondary septa.

I have for study one specimen from Duncan's original material, labeled Plesiastrea ramea Duncan, kindly sent to the United States National Museum by the authorities of the Geological Society of London, and 10 specimens belonging to the Museum of Comparative Zoology. The first specimen is not in very good condition for study, and does not fit Duncan's description well. The Museum of Comparative Zoology specimens, however, fit exactly, omitting the remarks about the coctae being covered by epitheca. The figures presented on Pl. , figs. , are based on these specimens.



*Orbicella altissima* (Duncan).

Pl. fig.

1867. Heliastrea altissima, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, pp. 12, 24, Pl. II, fig. 3.

Original description:

"The corallum is very massive and tall, and its upper surface is subplane and wider than the base. The calices are barely above the common surface, they are circular, but occasionally deformed, and they are slightly unequal in size. The calicular fossa is shallow, and the calicular margins are broader than the septa. The columella is small, distinct, lax, and parietal. The costae are well marked, unequal, and rarely touch, and they are thicker than the septa. The costae of the highest order are well developed, and contrast with their rudimentary septa. The septa are delicate, they are thinner midway than elsewhere, and those which reach the columella have a paliform tooth; they are not exsert, and are only slightly dentate. The septa are very



irregular in their arrangement. There are six systems, and in most of them there are three cycles with or without a part of a fourth in one-half of the system, so that there are constantly six septa in a system instead of eight. The endotheca is well developed; and the dissepiments are close, stout, and nearly horizontally parallel. The exotheca is abundant, forming small cells with arched outlines. Height of corallum 6-8 inches. Diameter of calices 2/10 inch.

Locality.---St. Croix, Trinidad."

<sup>1/</sup> Gregory places Duncan's Heliastraea altissima in the synonymy

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<sup>1/</sup> Quart. Jour. Geol. Soc. London, vol. LI, p. 272, 1895.

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of Orbicella acropora (Linn.), without stating why. He may be right, but the calices are large for O. acropora (here called O. annularis) and the presence of quaternary septa make it probable that it is distinct. According to Duncan's figure every other septum reaches the columella, a septal arrangement which is one of the characteristics of O. annularis. I did not see the type in London, and think that until it is restudied or additional material has been collected at the type locality it will not be possible to reach a positive decision as to the validity of the species.



*Orbicella cellulosa* (Duncan).

Pl. fig.

1863. *Astraea cellulosa*, Durcan, Quart. Jour. Geol. Soc. London, Vol. XIX, pp. 417, 418, Pl. XIII, fig. 10.
1866. *Heliastraea cellulosa*, Duchassaing & Michelotti, Cap. Corall. Antilles, p. 26 (of reprint).
1867. *Heliastraea cellulosa*, Duncan, Quart. Jour. Geol. Soc. London, Vol. XXIV, p. 24.
1870. *Heliastraea cellulosa*, Duchassaing, Rev. Zooph. Antilles, p. 30.
1902. *Orbicella cellulosa*, Vaughan, Quart. Jour. Geol. Soc. London, Vol. LVII, p. 497.

## Original description:

"Corallum tall, and, judging from the disposition of the corallites, subplane above. Corallites very numerous, tall, slender, crowded, but distinct; usually cylindrical, but sometimes more or less prismatic from mutual pressure; varying in size.



The transverse section of the corallites is generally circular, now and then deformed. Septa crowded, linear; the primary are the largest, but often the secondary are nearly as large. The primary septa are of nearly the same thickness at the wall and throughout. There are six systems of four cycles; in imperfectly developed systems the fourth cycle is wanting, but the persistence of this cycle throughout all the systems is very generally decided. The fourth and fifth orders are very small, and when there are only three cycles, the third order is small; the septa are generally straight. Columella small and slightly developed. The wall appears to be stout. Costae attached to every septum, sub-equal, and not very greatly developed. Endotheca vesicular, greatly developed. There are often four dissepsiments dividing each interseptal space. Exotheca cellular and highly developed; exothecal cells small, more rectangular and larger than the endothecal cells. The reproduction is by extra-calicular gemmation; the smallest buds visible have three perfect cycles of septa.



From the Conglomerate of Antigua. Coll. Geol. Soc.

Dimensions.---Height of corallum several inches. Diameter  
of corallites from 1-2 lines."

"The minute details of the structure of this Coral have disappeared; but the brilliant porcellaneous silica which fills up the interseptal loculi and the exothecal cells is so easily distinguished from the dull colourless remains of the septa, dissepiments, and walls, that the characters described are easily seen in the specimens. In some parts of the specimens the sclerenchyma is whitish grey, and the interspaces are filled with dark homogeneous silica, just reversing the arrangement generally observed.

The intimate relation between this form and one from a later formation (the Chert) is very interesting. The latter (var. curvata) has the teeth on the septa preserved; and the septa of the third order curve towards those of the second near the columella. It has all the other structural peculiarities of the



older form, and is clearly a variety; for here and there, amongst the numerous individuals of the masses from the Inclined Strata, the septa of the third order are now and then seen to curve towards those of the second."

Remarks: The type of the species was examined in the Geological Society of London. The most nearly related species is Orbicella tenuis from which it differs by having the primary and some secondary septa thicker and longer than higher cycles. *O. cellulosa* is one of the widely distributed Oligocene species occurring outside of Antigua, Tampa, Fla., and near Bainbridge, Ga. The specimens from the continent, however, appear to have certain characters different from those from Antigua sufficiently constant to warrant giving them a varietal name. A specimen from Bejucal, Cuba, collected by Dr. Arthur C. Spencer, may be referable to this species; because of the recrystallization of the original calcareous matter of the skeleton, and other changes due to fossilization, it can not be positively identified. The calices are between 3 and 4 mm. in diameter. The six primary septa are constantly larger than the others. In one calice there seemed to be indications of quaternaries; the doubt in the identification of the specimens is due to inability to be sure of the presence or absence of quaternaries.



*Orbicella cellulosae* var. *silicensis*, var. nov.

Plate , Figs.

The two distinctive characters of this variety are, (1) the flat upper surface; (2) the rather large calices, which are occasionally only 4 mm. in diameter, usually 5 to 6, and sometimes 6.5.

Localities: Blue Springs, Flint River, 4 miles below Bainbridge, Hales Landing, Flint River, about 7 miles below Bainbridge, Ga.; silex bed, Tampa, Fla. The specimen from Bejucal, Cuba, previously mentioned, may belong to this variety.

Geologic horizon: Basal upper Oligocene.

Remarks: This is probably the most abundant fossil coral of basal Chattahoochee in the vicinity of Bainbridge, Ga.



*Orbicella cellulosa* var. *curvata* (Duncan).

Pl. figs.

1863. *Astraea cellulosa* var. *curvata*, Duncan, Quart. Jour. Geol. Soc. London, Vol. XIX, p. 418.

Original description:

"Corallites slender, long, close, sometimes compressed; circular in transverse section, except when compressed. Walls thin and delicate. Costae delicate, unequal, narrow at the base, tapering externally. Septa well developed, in six systems of four complete cycles. The primary septa are large, toothed on either side, not larger at any one point than at another. The secondary septa are smaller than the primary, and have a tooth near the columella. The tertiary are smaller than the secondary, vary much in size, often extend nearly up to the columella, and curve there towards the latter; they have lateral teeth, and a larger tooth at the end; or they reach only halfway, being either



straight or curved. The quaternary septa have wedge-shaped bases and spike-like prolongations, extend one-quarter the distance to the columella, and sometimes curve towards the tertiary. Columella lax and parietal. Endotheca greatly developed, subdividing the septal loculi by transverse bars. Exotheca distinct, cells small.

Dimensions.---Diameter of the corallites 1/5 inch; a bud 1 line in diameter has three cycles.

Chert-formation of Antigua. Coll. Geol. Soc. As a rule, this variety is curiously fossilized. "



*Orbicella megalaxona* (Duncan).

Pl. fig.

1863. Astraea megalaxona, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XIX, p. 420, Pl. XIII, figs. 12 a, 12 b.
1866. Heliastraea megalaxona, Duchassaing & Michelotti, Sup.  
Corall. Antilles, p. 86 (of reprint).
1867. Heliastraea megalaxona, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 24.
1870. Heliastraea megalaxona, Duchassaing, Sup. Corall. Antilles,  
p. 30.

## Original description:

"Corallum large. Corallites very numerous, crowded, very variable in breadth, long and slender; they have suffered much from mutual pressure, and although the walls are distinct, yet the corallites are often more or less polygonal; diameter from  $1/8$  to  $1/5$  inch. Walls thin. Costae small. Septa very deli-



cate, a little thicker at the wall than elsewhere, and very thin towards the columella; in six systems, the cycles varying greatly; thus, in many corallites there are two cycles, in others two cycles and a third in one or more systems. Three perfect cycles are seen in large corallites, and two additional septa in some (in the whole corallite). The primary septa have a tooth near the wall; the secondary are a little smaller than the primary. Columella lax, parietal, occupying a very large space.

The details can be made out in only one corallite, which has escaped the ruinous but remarkable fossilization that has destroyed them in most of the specimens. The details have nearly all disappeared in the mass, and the interseptal loculi look like blunt, thick septa. In some specimens the large space occupied by the columella is filled with silica of a white or of a black color, giving them a very curious appearance.

There are many corallites which appear to have been undergoing fissiparous growth, but it is evident that extra-calicular gemmation also occurred. There are few details left for a



diagnosis of the species. The recent *Astraea Pleiades*, a Pacific form, is the only known species with a low septal number and fissiparous growth; it differs from that just described in its costal arrangement, but is more closely allied to it than to any other Coral.

From the Chert-formation of Antigua. Coll. Geol. Soc."



Diploastrea  
*Orbicella tenuis* Duncan.

Plate , Figs.

Mr. Robert T. Hill obtained at a locality 4 miles west of Lares, Porto Rico, four excellent specimens of an *Orbicella*, that satisfy in all particulars Duncan's description of *O. tenuis*; however, as they are in a better state of preservation than Duncan's material some additional details can be discovered, and an opportunity to study the variation of some characters is given.

The corallum is pulvinate, with the calices confined to the upper surface and sides.

Dimensions:

Specimen	Greater diameter	Lesser diameter	Height	Remarks
No. 1	69 mm.	52 mm.	55 mm.	Specimen apparently somewhat crushed.
No. 2	87	70	58	
3 *	100	100	45	Specimen sub-quadrangular in shape.
4	126	97	64	
* Specimen figured				

As regards the calices, specimen No. 1 is somewhat the most interesting, although these along the top appear to have been somewhat deformed through lateral compression of the corallum. On the top, the valices have slightly elevated margins, .75 mm. is the maximum height, some of



3

them are rather deep, about 2 mm.; the diameter of the more nearly circular ones ranges from 3.5 to very slightly more than 4 mm.; the distance between adjacent calices is from a mere dividing ridge to 2 mm., the calicular edges, however, are unusually distinct. Around each calice and joining adjacent ones are equal, acute costae. On the sides near the lower edges, the calices flatten, become larger and more distant, are either circular or faintly hexagonal in outline. Diameter from 4.5 to 5 mm.; distance apart, from <sup>0.5</sup> to 2 mm.; the range in the distance apart is the same as on the top, but the calices are more uniformly separated. The costae are distinct, low, and even.

The number of septae to a calice is the same for both the top and sides, ranging from 26 to a few over 30. They are relatively thin, i.e., not so thick as the width of the interseptal leculi; they are thickened at the wall, forming a pseudo-theca, and are the principals thickened on their inner ends, bearing distinct paliform lobes. The primaries and secondaries are subequal, extend to the columella, and are paliferous; tertiaries shorter and thinner within the calice; quaternaries, when present, still smaller.

Columella only slightly developed.

The preceding description is based on a single specimen, No. 1 of the table. The principal variation shown by the other specimen, is in the distance apart and size of the calices, and the number of septa. In specimen No. 3 (see Pl. , figs. ), the calices are usually about .75 mm. apart, their diameter ranges from 3.5 to 3.7 mm.; as would be expected, the calicular outlines are polygonal; there are, on the larger calices, as many as 40 septa; the fourth cycle, however, seems never to be complete. Palar thickenings can be seen on the larger septa; colu-



mella poorly developed.

Prof. K.Martin, Director of the Geologisch Reichs Museum, Leiden,  
has submitted to me for determination some material from Cerro Colorado,  
Aruba, that seems referable to this species.



*Orcicella cavernosa.* *Corypha*  
(For synonymy see original description.)

This species is so variable that great difficulty has been experienced in constructing an intelligible description. A very interesting specimen, obtained by Prof. Duvernoy in Jamaica and presented by him to the United States National Museum, will first be described in detail as it shows within itself a wide range of variation and indicates the lines of variation of other specimens more constant in their characters.

The corallum is oblong with the upper surface convex but not uniformly arched or domed; base epithecate. Length, 25 cm.; breadth, 20 cm.; thickness, 11.3 cm.

The specimen has two different kinds of calices. Those of one kind are rather distant, protuberant, and have subequal, not very tall, thick, dentate costae. The transverse outline is circular or broadly elliptical, diameter between thecal summits 8 mm.; one of the elliptical calices has a greater diameter of 11 mm., lesser about 8 mm. The costae are about 1 mm. tall. The distance apart, measured between the outer costal edges, is from almost contiguous to 6 mm. The free limb of the coralite is sub-cylindrical and may project between 6 and 7 mm. The calices, as is shown by Pl. , figs. , are not uniformly distributed, and vary in size, form, and prominence.

In a fully developed calice there are 48 septa, every other one extending to and fusing to the columella. All the septa, particularly the principals, are rather thick. The margins are dentate, within the calicular cavity they fall abruptly to the bottoms of the calices, which are 3 to 4 mm. deep, and then the principals connect to the columella.



The columella is large, trabecular, with a papillate upper surface, diameter, as much as 4 mm. The columellar elements are rather often twisted and present a whorled appearance.

Endothecal dissepsiments rather delicate; exotheca, coarse and very vesicular.

The calices of the other kind (Pl. , figs. ) in their typical development are smaller than those of the first, their edges are only slightly elevated, and the septa and costae are decidedly thin and exert. Diameter of the calices from 5 to 8 mm.; septal margins 1 mm. tall.

The differences between these two kinds of calices are so great that it scarcely seems possible that they could belong to the same species; however, they occur on the same corallum where perfect intergradation can be traced.

Pourtalès, as far back as 1871, <sup>1/</sup> published the following important

1/ Mus. Comp. Zool., Ill. Cat. IV, p. 76.

notes on this species:

The call

"Much of the confusion in regard to the name of this species is due to the fact that it was generally described and figured from badly beach-worn specimens by the earlier writers. Such specimens have the septa and calicles worn away and the hard exotheca thus becomes prominent around the excavate calicles, so as to greatly change the appearance of the fossil coral. Another cause is the rather wide variations in the size of the calicles.

"The normal or average specimens have the calicles about 6 to 8 mm. in diameter, but occasionally a specimen occurs in which part or all of them may be 9-10 mm., or rarely, even 11 mm. in diameter. Sometimes, on crowded parts of large specimens, the diameter may be only 4 to 5 mm. The degree of elevation of the calicles is also more or less variable on a single specimen.

"The calicles may be pretty close together, where crowded, but in other cases they are separated by spaces of 4 to 6 mm. or more. The costae are usually well developed as denticulated, rounded, radial ribs, usually 48 in number.

"The septa are generally about 48, arranged in four regular cycles, but several of those of the last cycle are often rudimentary or lacking, reducing the number to 40-44. They differ in breadth and thickness according to the cycles; those of the last cycle are very thin and often bend toward and join those of the third cycle. The principal septa are exert, denticulated, and thickened at the wall. The columella is usually well developed and broad. The paliform teeth are distinct, but not very prominent. It sometimes forms hemispherical masses 4 to 5 feet or more in diameter.

"This species appears to be rare at the Bermudas, and probably occurs only on the outermost reefs. The only specimen seen by me from there was from near the North Rocks. (Centennial collection.) It is a hemisphere about 11 inches in diameter, of the typical form. It is common on the Florida reefs and throughout the West Indies. Bahia, Brazil; (Yale Mus.);= var. hirta, nov., with elevated corallites; roughly serrate, thin costae and septa; calicles deep, 5-6 mm. broad; septa narrow, perpendicular within, usually 40-44. Pl. XXIII, figs. 2, 2a."



The description of the Jamaican specimen, when taken in connection with the notes of Pourtales, gives a good idea of the extent of the variation of the species except in one particular, that of the septal arrangement. The normal, fully developed calices have four complete cycles of septa; however, sometimes the fourth cycle may not be complete while at others there may be a few quinaries. In the recent specimens the tertiaries usually, but not invariably, extend to the columella; in the fossil specimens from Tampa, Fla., Bainbridge, Ga., etc., the primaries, some or all of the secondaries, and occasionally some tertiaries reach the columella. In the recent material the rule is for every other septum, in the Oligocene fossils for every third septum to reach the columella; but in some recent specimens the tertiaries are shorter than the secondaries, and in some of the fossils the tertiaries may equal the primaries and secondaries in length, thus showing that there is intergradation between the two plans of septal arrangement.

The characters common to all of the specimens may be briefly summarized as follows:

Corallum massive, base epithecate, upper surface flat, irregularly convex or domed. Calices more or less elevated, diameter from 5 to 11 mm., externally costate. Septa normally in four complete cycles, but the fourth may not be complete, and sometimes there may be a few quinaries. Columellar trabecular, well developed, large, with a papillary upper surface.



Remarks on the synonymy of *O. cavernosa*.— The names *O. radiata* (Ell. & Sol.), *O. argus* (Lam.), *O. conferta* Milne (Edwards & Haime), *Ov. endotheca* (Duncan), *O. cylindrica* (Duncan), *O. antiguensis* (Duncan), *O. radiata* var. *intermedia* (Duncan), *O. brevis* (Duncan), *O. aperta* Verrill, *O. cavernosa* var. *hirta* Verrill, and *O. compacta* Rathbun ms., are definitely placed in the synonymy of *O. cavernosa*, and it is thought probable that *O. antillarum* (Duncan), *O. costata* (Duncan), *O. insignis* (Duncan) and *O. brasiliiana* Verrill, should be referred to it. These named will be discussed seriatim.

Gregory applies *O. radiata* to the species as he considers the Linnaean definition of Madrepora cavernosa insufficient, an opinion with which I do not agree. All the Linnaean descriptions are unsatisfactory, but in this instance he refers to the figures of Leba, places the Madrepora astroites of Pallas in its synonymy, and states "Habitat in *O. Americano*." Taking all things together, the original diagnosis with the reference, seem to me sufficient for purposes of identification,—in fact, the brief Latin description is not bad. *O. radiata* was supposed to differ from *O. cavernosa* by possessing only three cycles of septa. Pourtales states in the quotation already made from him, that "In worn specimens the last cycle disappears first, for that reason probably Orbicella (Madrepora) radiata Ellis has been characterized by Milne-Edwards and Haime as having but three cycles."

Lamarck's Astrea argus is a new name for the Madrepora cavernosa Esper. The reason for his giving it is not evident.

The specimen identified by Ehrenberg as Explanaria argus, which is the type of Milne-Edwards and Haime Astrea conferta, is in the Berlin Museum fur Naturkunde, and the following notes are based upon it:



The specimen is much worn and is apparently somewhat fossilized. The calices are not regularly rounded but frequently are of irregular polygonal outline. The greatest diameter of an average calice is 8.5 mm.; lesser 7 mm. Thickness of wall between the calices 2.5 mm. In one calice there were 21 large and 21 smaller septa, there may be four complete cycles in some calices. The columella is very large and vesicular and occupies the greater part of the corallite cavity. Dissepiments abundant, about 13 to 5 mm., they slope downward and inward.

quoted

From reading the Pourtales description/above, it will be evident that this is only a variety of O. cavernosa with crowded calices. The Explanaria radiata of Ehrenberg is the ordinary Heliastrea cavernosa as figured by Milne-Edwards and Haime, excepting the fourth cycle of septa may not always be complete.

Astraea endothecata Duncan. The corallite walls are thick, the last cycle of costae are small and thin, and there appear to be no septa corresponding to them, occasionally there is a rudimentary septum of the fourth cycle. The last cycle of septum may have been broken off; or the wall, because of subsequent thickening, may have included their inner ends. Diameter of corallites from 8 to 10 mm. Type in the Geological Society of London; duplicate in the U. S. National Museum. The preceding remarks are based on the latter.

Astraea cylindrica Duncan is similar to O. endothecata, except it has smaller corallites, from 5 to 6 mm. in diameter. Type Geological Society of London; duplicate in the U. S. National Museum. A specimen collected by Mr. Robt. T. Hill, Edge Cliff summit, Barbados, is intermediate between O. endothecata and O. cylindrica.



Astraea antiquensis Duncan differs from the usual recent specimens of the species by having the tertiary septa a little smaller than the primaries and secondaries. Duncan states that "The primary and secondary septa have a tooth near the columella." The specimen from Lares, Porto Rico, represented by Pl. ., fig. ., seems almost typical antiquensis; the type is represented by Pl. ., fig. .

Astraea radiata var. intermedia Duncan is, according to its original description, characterized by "having the third cycle of septa complete, and a little excess of vesicular endotheca. \* \* \* The variety forms a link between the great Astraeans of the Miocene of the Antilles and the existing Astraea radiata of the Caribbean Sea, Astraea antillarum being closely allied to it." The type specimen, Geological Society of London, is represented by Pl. ., fig. . There are in places indications of small costae between the larger ones, similar to those of O. endothecata, and there are a few quaternary septa.

Astraea brevis Duncan is a variation of O. cavernosa with corallites about 5 mm. in diameter, and rather elevated calices. The type, Geological Society of London, is represented by Pl. ., fig. .

Heliastraea aperta Verrill, from Brazil, is especially characterized by having the principal septa, i. e., those of the first, second, and third cycles, all of which ordinarily reach the columella, taller and thinner than is usual in O. cavernosa.

Orbicella cavernosa var. compacta Vaughan has solid exotheca, low mammillate corallites, and equal costae. Recent on the Brazilian coast, Lat.  $12^{\circ} 48'$  S. Long.  $38^{\circ}$  W., 27 fathoms.

Asterion cylindrica Duncan is a

Astraea costata, Astraea antillarum, and Heliastraea insignis of Duncan, probably should be placed in the synonymy of O. cavernosa; however, as I do not feel confident of their relationship, they will be treated as separate species.

This discussion may be closed by stating that Verrill<sup>1/</sup> has named

1/ Trans. Conn. Acad. Sci., vol. xi, p. 101, 1902.

Quelch's Orbicella cavernosa from off Barra Grande, Brazil, 30 fathoms deep, O. brasiliiana, without giving a description. He quotes from Quelch that its exotheca is so vesicular as to partly hide the costae; and that its septa are uniformly thickened.

Localities: Recent. The Caribbean and Gulf regions wherever coral reefs are particularly developed; also the coast of Brazil.

Fossil. The Pleistocene reefs of the Antilles. Also the Oligocene of Serre Colorado, Aruba; Antigua; Lares, Puerto Rico; Anguilla; Tampa, Fla.; 15 miles south of Valdosta, and along the Flint River in the vicinity of Bainbridge, Ga.

Geologic distribution:- From the upper Oligocene to Recent.

#### Varities of Orbicella cavernosa.

The material before me seems to warrant the recognition of at least four varieties; by reference to the descriptions and notes that precede, it will be seen that they are not of specific value.



Orbicella cavernosa var. tampaensis var. nov.

Plate , Fig. .

The corallum forms head-shaped masses the size of a man's fist and smaller.

Calices decidedly elevated, up to 4 or 4.5 mm.; diameter 6 to 10 mm. Costae prominent.

Septa in four cycles, the last usually more or less incomplete. The primaries and some or all of the secondaries, occasionally a tertiary, reach the columella. Usually there are three or four different sizes.

Margins exsert.

Columella ~~more slender~~ than on the other forms of the species.

Locality: The Silex bed, Tampa, Fla.; Lares, Porto Rico.

Geologic horizon: Upper Oligocene.

Type: Wagner Free Institute of Science, Philadelphia.

Paratypes: United States National Museum.

Orbicella cavernosa var. silecensis var. nov.

Plate , Fig. .

Corallum oblong, irregularly convex above; type about 16 cm. long, 11 cm. wide, and 9.5 cm. high.

Calices slightly elevated, the corallites somewhat swollen below the calicular edges. Diameter, 8.5 to 9.5 mm. Costae prominent.

Septa in four cycles, usually differentiated in size, according to cycle, primaries and secondaries and occasionally some tertiaries reaching the columella. Margins exsert.



Columella rather well developed.

Locality: The Silex bed, Tampa, Fla.;

Geologic horizon: Upper Oligocene.

Type: Wagner Free Institute of Science, Philadelphia.

Remarks: This specimen seems to intergrade with the variety just described, and is represented in the Recent fauna by that portion of the Duerden Jamaican specimen figured on Pl. , fig. . The septa of the Recent specimen, however, alternate in size, while those of the fossil are in three sizes. This difference, although it is of importance, is not absolutely constant.

Orbicella cavernosa var. bainbridgensis var. nov.

P Plate , Fig. .

This variety is in superficial appearance similar to the Recent specimens with low calices, and low equal costae; it differs by having the septa usually in three instead of two sizes.

Locality: Flint River, 4½ miles below Bainbridge, Ga.

Geologic horizon: Upper Oligocene.

Type: United States National Museum.



*Orbicella cavernosa* var. *anguillensis* var. nov.

Pl. , figs.

This variety is characterized by having large calices, some of which may be distant and prominent.

Dimension of calices.

	1	2	3	4	5	6	7
Greater diameter	18.5 mm.	15 mm.	12 mm.	14.5 mm.	15 mm.	14 mm.	11 mm.
Lesser diameter	14.5 "	14.5	12 "	12.5	14 "	12.5	9.5

The young calices, of course, are smaller.

Distance apart 7 to 20 mm. Isolated calices may be decidedly prominent, 5 mm. or more in height. Depth, moderate.

The corallites externally are strongly costate, large costae tall and thin, alternating with much smaller ones. The intercostal spaces ~~are~~ wider than the costae.

Septa in the larger calices between 70 and 80, the various systems and cycles are not distinctly differentiated, about 24



reach the columella. Within the wall the septa are thin, in the thecal ring they are thicker, the costae are thicker than the inner portions of the septa.

Columella large, composed of twisted, interlacing, fused inner ends of septa. Its diameter about  $(1/3)$  the diameter of the calice.

Locality: Island of Anguilla, West Indies, P. T. Cleve,

Collector.

Geologic horizon: Upper Oligocene.

Type: University of Upsala.

Remarks: Three specimens belonging to the University of Upsala collection are typical, although they show some variation. Four other specimens show a gradual approach to the form or variety of *O. cavernosa* in which the costae are strongly alternating in size - there is a decrease in both the size and prominence of the calices. These four specimens are figured on pl.



*O.cavernosa* var *anguill.*

with them before one it does not seem possible to ~~clearly~~ sharply separate, the large and prominent caliced specimens from these with smaller (7 mm. in diameter), and only slightly prominent calices.



Additional note: The specimens from Serro Colorado, Aruba, deserve special notice. The corallites are circular in cross section, and have a diameter of a centimeter, sometimes slightly greater. The distance between them is 3mm. or even greater. Endotheca and exotheca are very richly developed. The septa are usually 24 in number, alternately larger and smaller, all of the larger reach the columella; occasionally small quaternaries. They are thin, but are thickened at the wall sufficiently to form a so-called "pseudotheca." There are two specimens of this coral from Serro Colorado, one of which is completely silicified, and a large portion of the other has undergone silicification. The columella is lax, spongy, and fairly large, occupying about one-third of the diameter of the corallite cavity. These specimens closely resemble Duncan's var. intermedia, but have somewhat larger corallites; they are very near O. costata (Duncan), from which they differ by having thicker septa and a larger columella; O. antillarum differs by its somewhat smaller corallites; I can discover no noteworthy difference from O. insignis Duncan. These specimens, particularly when taken in connection with the other material that I have studied, lend strong support to placing each of the names just mentioned in the synonymy of O. cavernosa.



*Orbicella antillarum* (Duncan).

Pl. fig.

1863. Astraea antillarum, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XIX, p. 443.

1866. Astraea antillarum, Duchassaing & Michelotti, Sup. Corall.  
Antilles, p. 86 (of reprint).

1867. Heliastraea antillarum, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 24.

1870. Heliastraea antillarum, Duchassaing, Rev. Zooph. Antilles,  
p. 30.

may be a form of *Orbicella cavernosa*, and  
This coral/was doubtfully referred by me<sup>v</sup> to the synonymy  
that species; however, as there is doubt in the matter, it is here  
of Orbicella cavernosa.  
accorded specific treatment.

----- ✓ Samml. Geologisch. Reichs. Mus. Leiden, Ser II, Bd. II,  
Heft. I, p. 28, 1901.  
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Original description:

"A specimen in the form of a rolled flint, found with silicified Wood, has the corallium large, tall, probably resembling in shape that of the San-Domingan A. exothecata. Corallites close, unequal in size, but quite distinct; the transverse section shows them to be circular in outline. Septa in six systems of three cycles. The primary and secondary septa are nearly equal, and reach to the columella; the tertiary are small and straight; all are slender, wide apart, and very distinct. Costae tolerably developed, subequal. Walls moderately developed, by no means strong. Columella small, and occupying a small space. Endotheca greatly developed, vesicular, and forming cells between the septa. Exotheca well developed; large cells broad, others squarer, with shelving dissepiiments. Diameter of the corallites  $\frac{3}{10}$  inch. = 8.3 mm.

The interspaces are filled with opalescent or porcellanous silica; sclerenchyma often destroyed.

Coll. Geol. Soc."

Locality: Montserrat.



Duncan in Quart. Jour. Geol. Society of London, Vol. XX,  
p. 36, Pl. IV, fig. 2, lists a coral as Astraea antillarum var.,  
and makes the following note:

"With more distinct calices than the type, produced costae,  
and a less perfect development of the third septal cycle. The  
exact locality is not known, but the Coral, from its mineralogical  
characters, appears to have been obtained from Antigua. Brit.  
Mus."

Remarks: By comparing the description of O. antillarum with that  
of O. cavernosa it will be seen that the two are similar, except the  
former has only three cycles of septa. As there is in the latter con-  
siderable variation in the development of the fourth cycle of septa, and  
as they are often very small and may be destroyed, something especially  
likely to occur in worn specimens, such as fossils usually are, it seems  
probable that O. antillarum should be placed in the synonymy of O. cav-  
ernosa.



*Orbicella insignis* Duncan.

Pl. fig.

1867. *Heliastraea insignis*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, pp. 19, 24, Pl. I, fig. 4.

Original description:

The corallum is large, and the corallites also; they are wide apart, are circular in transverse outline, and are very equal in size. The wall is stout as regards the septa and costae, but thin in comparison with the diameter of the corallites. The septa are delicate, wide apart, long, slightly thicker at the wall than elsewhere, straight, and the primary septa are hardly any broader than the tertiary. There are three cycles of septa in the six systems, and rarely a septum of the fourth cycle is noticed in half of a system. The primary and secondary septa are of equal length, and the tertiary extend far in towards the columella. The columella is small. The costae are long, slender,



often bent, almost equal, and of about the same thickness as the septa; occasionally a rudimentary costae is seen, and is not represented by a septum. The exotheca is inclined and abundant. The endotheca is very abundant and inclined.

Diameter of corallites (costae not included) 4/10 inch.

Loc. Antiguan Tertiary deposits.

The large size of the corallites, the low septal number, the long septa and costae, with the small columella and highly developed endotheca, distinguish this species."

It has already been stated in discussing the synonymy and variations of *O. cavernosa*, that *O. insignis* should probably be placed in its synonymy.



*Orbicella costata* (Duncan).

Pl. fig.

1863. *Astraea costata*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XIX, p. 422, Pl. XIII, fig. 9.

1867. *Heliastraea costata*, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 24.

Original description:

"The specimens of this species which I have examined present polished longitudinal and transverse sections of corallites, but I have seen no calices. Corallites long, parallel, sometimes deformed, generally circular in transverse outline, not crowded, but close, varying in size. Intercorallite spaces very distinct. Walls thin, not thicker than the delicate septa. Costae large alternately, both sizes equally produced; wedge-spined at the wall, pointed, and often bent at the free end. Septa all delicate and linear near the columella and in the middle; at the wall



their base is narrower than that of the costae. They are arranged in six systems, the cycles being very irregular. In three systems there are three cycles, and in the rest an incomplete fourth; rarely there are two systems with four complete cycles; the fourth and fifth orders often curve towards the third order. Lamellae rather cribriform, joining the columella by oblique processes. Columella lax, small, and formed by dissepiments from the septa and a central spongy mass. Endotheca very abundant, vesicular, and horizontal, with four or five dissepiments in 1/10 inch. Exotheca abundant, nearly equal to the endotheca. Reproduction by extra-calicular budding. Diameter of the corallites from 3/10 to 7/20 inch.

This species is closely allied to the Astraeans with great endothecal development, and especially to Astraea vesiculosus, Edwards and Haime, from Dax, as well as to A. Antillarum, nob., and A. endothecata, nob. "

Locality: The marl of Antigua.

Remarks: The relations of O. costata to O. cavernosa have already been considered in discussing the synonymy and variation of that species.



*Orbicella gabbi* sp. nov.

Pl. fig.

(Description to be written later).

Locality.---Santo Domingo (Gabb Collection).

Geologic horizon.---Unknown.

Type.---Academy of Natural Sciences of Philadelphia.



*Orbicella* spenceri, sp. nov. (This is not an  
Orbicella)

Pl. fig.

1901. *Orbicella* sp., Vaughan, Quart. Jour. Geol. Soc. London,  
Vol. LVII, p. 497.

(Description to be written later).

Locality.---Antigua, West Indies (J. W. Spencer, Collector).

Geologic horizon.---Upper Oligocene.

Type.---United States National Museum.



*Brachyphyllia eckeli* Duncan.

Pl. fig.

1867. *Brachyphyllia eckeli*, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, pp. 13, 24, Pl. II, fig. 4.

Original:

"The corallum is large, massive, and irregular. The coralites are cylindrical, of various lengths, and are not always parallel, neither are they equidistant; they are not free, but their calices are more or less continuous by means of the costae. The walls are stout and independent. The calices are large, and are of various depths, and they do not rise as truncated cones; but their interspaces are broad, convex, and are traversed by the more or less continuous costae. The columella is small, spongy, and prominent. The septa are numerous, unequal, and crowded; they are thicker at the wall than elsewhere, are barely exsert, and are faintly dentate. They are usually forty-eight in number. There are six systems and four cycles, and some orders of the



*Brachyphyllia eckeli*

fifth sometimes exist. The doubly laminar condition of the septa is very distinct. Most of the septa join the columella, and those of the fourth and fifth orders frequently curve towards the larger septa. The costae of the principal septa, and often those of the others, touch or unite to the corresponding structures of the neighboring calices. The costae are not so unequal as the septa, are faintly dentate, but slightly exsert, and are very distinct. The endotheca is sparsely developed, and the exotheca exists. Diameter of calices 4/10 inch.

Locality. St. Croix, Trinidad."



*Brachyphyllia irregularis* Duncan.

Pl. fig.

1867. *Brachyphyllia irregularis*, Duncan, Quart. Jour. Geol. Soc. London, Vol. XXIV, pp. 13, 24, Pl. II, fig. 5.

Original description:

"The corallum is short, and has a very irregular upper surface, and an encrusting base. The corallites are very irregular in their shape and dimensions. The calices are crowded, deformed, and irregular. The calicular fossa is deep. The columella is very small. The costae are continuous, and alternately very large and very small. The septa are irregularly developed, are alternately large and small, and never exceed three cycles in six systems. There is much exotheca. The largest calices are rather more than 1/12 inch in diameter.

Locality. St. Croix, Trinidad."



Genus CYPHASTREA Milne-Edwards and Haime.

1846. Orbicella Dana (part) Zooph. Wilkes Expl. Exped., p.
1848. Solenastrea Milne-Edwards and Haime, Comptes Rend. Acad. Paris, t. xxvii, p. 494.
1848. Cyphastrea Milne-Edwards and Haime, Comptes Rend. Acad. Paris, 3 t. xxvii; p. 494.
1857. Cyphastraea Milne-Edwards and Haime, Hist. nat. Corall., t. 11, p. 495.
1857. Solenastraea Milne-Edwards and Haime, Hist. nat. Corall., t. 11, p. 495.
1873. Cyphastraea Klunzinger, Korallith. Roth. Mebr., III Th., p. 50.
1885. Solenastraea Duncan, Jour. Linn. Soc. Lond., Zool., vol. xviii, p. 107.
1885. Cyphastraea (as subgenus of Solenastraea) Duncan, Jour. Linne. Soc. London, Zool., vol. xviii, p. 107.

Dana's Orbicella was, as has been stated in discussing it, a composite genus. Klunzinger was the first to combine the Cyphastrea and Solenastrea of Milne-Edwards and Haime in one genus, applying the former name, although it occurs lower down on the page when the two were originally described than the former. Duncan adopts Solenastraea as the generic name, and retains Cyphastraea as a subgenus. If the two are to be combined we must follow Klunzinger and apply Cyphastraea.

Cyphastraea is separable from Orbicella solely by having the surfaces between the calices not ribbed or with lamellate costae, but ornamented with spinules and granulations. The compactness of the exotheca is variable, as is also the porateness or compactness of the septa.



*Cyphastrea hyades* Dana.

Professor Verrill has studied Dana's types of Orbicella hyades in the collection of the Boston Society of Natural History, and gives  
the following description:

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1/ Trans. Conn. Acad. Sci., vol. xi, pp. 104, 1902.

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"Calicles circular, or nearly so, mostly 3 to 3.5 mm. in diameter, are scattered between the full grown ones. In the middle of the convex summit the calicles are so crowded that the walls are in contact, and here they often become angular by crowding, and when not in contact their edges may not be elevated. On other parts they may be separated by intervals of 2 or 3 mm. or more. The walls are very thin. The costae are thickened and roughly minutely serrulate; they are very narrow and mostly confined to the wall, never extending across the exothecal spaces, when these occur. The surface of the exotheca is smooth or vesicular; in sections the exotheca is openly vesicular.

"Septa 20 to 24, mostly 24 in mature calicles; 12 extend to the columella; those of the third cycle are also wide, but thinner, and most of them bend toward and join the larger ones about midway between the wall and columella. The septa all become thin and curved toward the columella, but thickened at the wall; the summits are narrowed and rather prominent above the walls; inner edge irregularly and roughly serrulate, especially distally; sides roughly granulated. Paliform lobes small and thin. Columella usually rather small and loose; formed of small twisted processes from the inner edges of the septa, but variable in size.

"Thickness of the larger mass from St. Thomas, about 50 mm.; diameter 125 mm.; diameter of calicles mostly 3 to 3.5 mm., rarely 4 mm.

"This species is found on the Florida Reefs and throughout the West Indies. It has not been found at the Bermudas. St. Thomas (coll. C. F. Hartt, Yale Mus.). In the Amer. Museum, New York, there is a large turbinate mass, 12 to 14 inches in diameter and about 10 inches high, from Jamaica."

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The same author gives the following description of Orbicella  
excelsa Dana:

1/ Trans. Conn. Acad. Sci., vol. xi, pp. 98, 99, 1902.

"Dana's type of this species, in the Boston Society of Natural History, was carefully studied by me a number of years ago, and descriptions were made at that time. The type is apparently slightly beach-worn, but so little that the natural surface of the coenenchyma and costae, and the summits of the septa are well preserved in most parts, and there is no evidence of post-mortem alteration by infiltration to account for the solidity of the coenenchyma, referred to by Dana, and which is, indeed, quite remarkable in most parts. The coral is very solid and heavy as contrasted with O. annularis or Splenastraea hyades.

"A fragment, apparently of the same specimen, and which appears to have been used by Dana in describing the details, is preserved in the Museum of Yale University. From this the accompanying photograph has been made. (Pl. xv, fig. 4.) The coral grows in irregular, often upright, lobed or gibbous masses, up to 100 to 150 mm. or more high, but when young it must be encrusting. No. 1729.

"The type specimen is so strongly lobed that the lobules in some places look like incipient branches. But these may possibly be due to the coral growing over the tubes of invading bivalves or annelids, though none can be seen without sections. The calicles are more closely crowded on the lobules, especially at the obtuse summits, where they become angular and are separated by thin walls and cellular exotheca. Elsewhere the calicles are nearly circular, scarcely elevated, and separated by exothecal spaces usually about equal to the radii of the calicles, but toward the base often equal to their diameters. The exotheca and walls are very solid in most parts.

"The 24 costae are subequal, thickened, only slightly raised, faintly or almost microscopically granulated; those of adjacent calicles are usually separated at the surface by a slight intermediate groove, forming polygonal areas around the calicles. The exotheca is nearly level with the edges of the walls and costae, flat or slightly concave, minutely granulated or nearly smooth, sometimes slightly vesicular at the surface, but usually almost solid and blended with the costae and walls; near the tips costae unite and exotheca is cellular.

"In a transverse section, near the surface, the entire partition between the calicles may be perfectly solid, whether thick or thin, but in many cases one or two rows of small, rounded or crescent-shaped vesicles can be seen, and sometimes, close to the surface, vesicular dissepsiments are visible between the small costae, while close to the basal margin of the coral the exotheca may be decidedly vesicular, appearing almost like miniature honey-comb transverse sections. But this basal portion is formed by the thin, down-growing margin, where the new calicles are very short, oblique, and far apart, as in many other corals that have a thin, proliferous margin.



"The septa are generally 24, subequal, in three regular cycles; those of the first two cycles are nearly equal in height and thickness; those of the third cycle are thinner and narrower, and generally bend to the right and left in pairs to join the straight septa of the second cycle, usually at a point more than half-way to the columella, and often very near it. The summits of all the septa are narrow and only slightly raised above the walls. The edges are irregularly serrulate, two to four of the basal teeth being the larger. The sides are distinctly granulated. The septa are all thin, but slightly thickened toward the wall, and all are narrowed above the base, so as to leave a cup-like calicular cavity. The columella is small, trabecular, papillose, and often nearly wanting. In transverse sections of some calicles it is solid, and formed by the union of the inner edges of the septa, but in most it is small, porous, trabecular.

"Diameter of the calices 2.5 to 3 mm.; breadth of intercalicial spaces, usually 1 to 2 mm., sometimes up to 3 to 4 mm. or more, near the base.

"Origin uncertain, supposed to be West Indies. Several irregular gibbose masses of this species, 3 to 5 inches in thickness, in the Amer. Mus. New York, were found near Osprey, West Florida, cast on the beach, after a storm, by R. P. Whitfield (No. 485). I have also seen specimens from Key West."

Verrill keeps O. hyades and O. excelsa separate, with the remark, however, that "they may eventually prove to be one species." The differences between the two consist in the latter possessing a much more solid exotheca and more developed costae. There is in the United States National Museum a moderate suite of Recent specimens, and an excellent one of fossils. I feel convinced that the two forms are only variations of the same species, as in the same specimen the exotheca may be solid or vesicular; and the costae may be confined to the corallite periphery or extend from one corallite to those of the next. Although Prof. Verrill's descriptions are so comprehensive as to render a new one unnecessary, I should like to call attention to some features not considered in detail by him. The costae seen on the surface are not prolongations of the distal end of the septa, they are only striations on the exothecal surface corresponding in position with the septa.



The exotheca is usually built up of more or less horizontal platforms, which when closely applied one above another give rise to a compact, or even a solid exotheca; if the platforms are separated, the intervening spaces contain vesicular disseppiments. In some instances the exothecal surface is formed by thin-walled vesicles. The septal trabeculae are directed upwardly at a low angle, and have their courses indicated by rather small and crowded granulations. The inner septal edges or trabeculae from the edges fuse to form a false columella. The septa usually are imperforate; however, in some instances perforations occur between the trabeculae near the columella, but never so abundantly as in Orbicella annularis.

Localities: Recent specimens in the United States National Museum: Osprey, Fla., T. Wayland Vaughan; southern Florida, S. T. Walker; Caesars Creek, Fla., Edw. Palmer; Cedar Keys, Fla. Lieut. J. F. Moser, U.S.N.; Reefs near Miami, Fla., J. A. Benedict.

Fossil: Shell Creek, and Calcosahatchie River, Fla.

Geologic horizon: Pliocene.

Remark: The Madrepora stellulata of Ellis and Solander is probably this species. If the tertiary septa were represented as fusing to the sides of the secondaries I should feel sure of it.

The exotheca is usually built up of more or less horizontal plates,  
which when closely applied one upon another

*Cyphastrea caribaea* (Duchassaing and Micheletti).

Corallum forming spheroidal or dome-shaped masses, sometimes as much as a foot, or even more, in diameter; the outer surface uniformly rounded or with gibbosities.

The succeeding portion of the description is based upon a single head-shaped specimen, 15.3 cm. tall, greater diameter 12.8 cm., lesser, 11 cm.

The calices have very slightly elevated margins, and thin corallite walls. Diameter from 2 to 2.5 mm. Distance apart from .75 to about 2 mm.; usually about 1 mm., or half the diameter of the calices. The depth of the calicular fossae can not be determined with certainty, as the specimen is worn; where it is best preserved they are shallow. The corallite walls externally are costate, a costa corresponding to each septum; the costae, however, are short, those from one corallite not extending to those of the next. Between the corallites are thin-walled exothecal vesicles, which have a horizontal/stratified arrangement (see Pl. , fig. ). The outermost exothecal platform may show costal striations.

The septa are thin, somewhat thicker at the wall; uniformly in three complete cycles; primaries and secondaries equal and reaching the columella; tertiaries only about half as long; thinner, inner margins free. Rather wide, thin pali occur before the first and second cycles. The septal faces are finely granulate, with the course of the trabeculae indicated; no perforations could be discovered. Thin endothecal dissepsiments present. Columella poorly developed, rather small and lax.



Localities: Caloosahatchie River, Florida, Frank Burns; Shell Creek, Fla., Dr. Griffith; Santo Domingo, W. M. Cabb; Moen Hill, Costa Rica, H. Pittier.

Geologic horizon: The Florida specimens are Pliocene, and it is likely that the others are of the same age.

Variation: The United States National Museum possesses a very good suite of specimens of this species, permitting a rather satisfactory study of its variation. The specimen already described shows within itself the limits of variation in the size and distance from one another of the calices. About 2 mm. is the average calicular diameter. The exotheca may be very light and delicate, or rather compact, even almost solid. The septa vary in thickness and the pali may be strongly or weakly developed; when strongly developed they are triangular in shape, the base of the triangle directed outward, and the tertaries may fuse to the basal corners or to the sides of the pali before the secondaries. The thickened pali are correlated with the denser exotheca, the various skeletal elements seem to thicken together.

Synonymy: Of the species described by Duchassaing and Michelotti, Plesiastrea carpinetti, Leptastrea caribaen, Solenastrea micans, and Solenastrea ellisi can confidently be placed in this synonymy.

The original description of P. carpinetti is as follows: "The form of the corallum and lobed; the calices are small, and often slightly deformed with prominent margins, separated by distinct costae and vesicular tissue: the septa are finely denticulate and do not attain a length of one-third the radius of the calice because of the development of the pali. The last are thick, as strong as the septa,



when examined with a lens they appear covered with granulations; the columella is formed by papillae similarly granulate."

Original description of Leptastrea caribaea: "Species globular, with calices almost contiguous, circular, margins elevated; columella simple, septa alternately smaller." St. Thomas.

Notes on type: Calices, 2 to 2.5 mm. in diameter; margins slightly elevated. Septa of the last cycle rarely fused to the sides of the secondaries; paliform lobes insignificant or absent. Columella with papillate upper surface.

Original description of Solenastrea micans: "Corallum orbicular, with crowded calices, circular, but often deformed, diameter about a line [2 mm.]; their upper margin is free, projecting above the rest of the surface; the septa are very echinulate and thicken outwardly; the columella is thick and vesiculate." St. Thomas.

Notes on type: The calices are crowded; 2 to 3 mm. in diameter. Septa in two complete cycles, with a few tertiaries; primaries and secondaries of the same size.

Solenastrea ellisi, according to Duchassaing and Michelotti, "has for a synonym the Astrea pleiades figured in the work of Ellis and Solander, Nos. 1 and 4 of Plate 53." There is a specimen, probably the type, in the Museum of Natural History at Turin, labeled Solenastrea ellisi. It has small calices, 2 mm. in diameter; and three cycles of septa, the last very small.

Duncan's Plesiastrea distans and P. globosa, from the silt of the sandstone plain of Santo Domingo, belong in the same synonymy. The types of both species are preserved in the collection of the Geological Society

when examined with the lens they appear

of London, where I have studied them. A duplicate of the latter is in the United States National Museum, figures of it are given in Pl. , figs. . The difference between P. distans and P. globosa consists in the calices of the former being one-half or more than one-half their diameter apart, while in the latter the distance between them is usually less than one-half this diameter.

Differential characters: Cyphastrea hyades and C. caribaea are closely related species. The calices of the former, however, are constantly larger than those of the latter, and the tertiary septa, except occasionally in young coralla, constantly fuse to the sides of the secondaries; the latter species has smaller calices, and except when the pali are decidedly thickened, has the inner ends of the tertiary septa free. These differences are constant in the considerable series of specimens that I have been able to study.



Doubtful Species of Cyphastrea.

Solenastrea turonensis (Michelin) Duncan.

1863. Solenastraea turonensis, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XIX, p. 422.

Duncan published these notes:

"Some imperfect specimens of this species from Antigua  
are contained in the collection of the Geological Society, but  
they add nothing to our knowledge of the species."

(~~Look up these specimens in the Geological Society of  
London and determine their synonymy.~~).

A silicified specimen, structure destroyed to so great a degree  
that neither the genus nor species can be determined.



*Solenastrea verhelsti* M. Ed. & H. var. fide Duncan.

1863. *Solenastraea verhelsti*, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XX, p. 40.

1867. *Solenastraea verhelsti*, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 25.

Duncan makes the following remarks:

"Corallum massive, short, flat, with a plane surface. Calices circular, close, almost equal in size. Wall very thin. Septa in three cycles and unequal in size; the primary are the largest, and the secondary, which are a little smaller, extend to the rudimentary columella, whilst the tertiary are small and reach but a little way inwards. All are sharply granular or subspinous laterally, and the free inner edges of the third order are bluntly but regularly dentate. Costae rudimentary, attached to each septum, rounded and blunt. Exothecal cells large, and about 1/20 inch in longitudinal measurement. Endothecal dissepim-



*Solenastrea verhelsti*

ments delicate, a little inclined, with the spaces between them smaller than the exothecal cells. Diameter of corallites in transverse section 3/20 inch; height 2 to 2 1/2 inches.

From the tufaceous limestone, San Domingo. Coll. Geol.

Soc.

The identity of this form with the *Solenastraea Verhelsti*, Edwards & Haime, of the Eocene of Ghent, is very remarkable; for fragility and increased delicacy of septa can not be admitted as evidence of anything more than a variation, induced probably by the comparative nutrition of the polypes. The dentate free edge of the smaller septa is very well marked, and is not noticed in Milne-Edwards's description. The San-Domingan Coral is therefore a very interesting form, and must be considered a variety of the Eocene species. It differs from the recent Antillian species *Solenastraea Bournoni*, Edwards & Haime, and all the other known recent forms, whilst the long, corallites and crowded septa of the Miocene *Solenastraea Turonensis* are too prominent peculiarities to be mistaken."



*Solenastrea columnaris* Reuss, Duncan.

Pl.                  figs.

1873. *Solenastraea columnaris*, Duncan, Quart.Jour. Geol. Soc.  
London, Vol. XXIX, p. 557.
1899. *Solenastraea columnaris*, Vaughan, Bull. Mus. Comp. Zool.,  
Vol. XXXIV, p. 229.

Duncan makes the following notes:

"This species was found by Catullo at Montecchio Maggiore,  
and was described by Reuss from Monte delle Carrioli, near Pole-  
sella, in the Castel-Gomberto district.

It is represented by several specimens from St. Bartholomew's  
in the West Indies, in Mr. P. T. Cleve's collection."



Genus DIPLOTHECASTRÆA Duncan.

1867. Diplocoenia, Duncan, Quart. Jour. Geol. Soc. London, Vol. XXIV, p. 20 (var. E. de Fromentel).
1884. Diplothecastræa, Duncan, Jour. Linn. Soc. London, Vol. XVIII, p. 115.

Type species: Diplocoenia monitor Duncan.

Original description:

"The corallum is massive. The corallites are polygonal and tall, united by a well-developed common wall, and present an external coenenchymal space, an internal wall, whence arose the septa, a lamellar columella, and oblique dissepsiments between the common and internal walls. Reproduction by gemmation in the coenenchymal space."



*Diplothecca straea monitor* Duncan.

Pl. fig.

1867. Diplocoenia monitor, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, pp. 21, 25, Pl. I, figs. 3 a - 3 c.

Original description:

"The corallites are crowded, and either hexagonal or pentagonal, and they are rarely four-sided. The inner wall is more or less circular, and the coenenchymal space varies in size and in the amount of endotheca. The external wall is stout, wavy, imperforate, and slightly higher than the internal. The septa arise from the inner wall, and very rarely from the outer, or from the coenenchymal space. The laminae are linear, straight, wide apart, and do not all project to the columellae, but one septum often does. Minute septa appear here and there between the others, which are subequal. The septal number is variable. In a small corallite there are 15 large septa and 3 small; in a larger, 13 large and 9 rudimentary septa; in other corallites 19



large and 5 small septa, 24 and 4, and 14 and 10 septa.

There are no costae. The columella is lamellar and flat, but very distinct, and is often joined to one or more septa.

The endotheca between the walls is inclined and vesicular, and rather abundant, and that within the internal wall and between the septa is very sparingly developed.

Diameter of largest corallites 5/20 inch, the coenenchymal space being about 1/20 inch wide.

The mineralization is siliceous; and the specimen is in the British Museum, among the Antiguan corals.

This is a very remarkable genus; for it is, as it were a Lithostrotion of the Palaeozoic Coral-fauna without tabulae.

There is nothing like it known; and the lingering of the old type in association with vesicular endotheca and an irregular septal arrangement which is certainly not hexameral is very interesting and suggestive."



*Astroria polygonalis* Duncan.

Pl. fig.

1863. *Astroria polygonalis*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XIX, p. 484, Pl. XIV, fig. 6.

1866. *Astroria polygonalis*, Duchassaing & Michelotti, Sup. Corall.

Antilles, p. 83 (of reprint).

1867. *Astroria polygonalis*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, p. 24.

1870. *Astroria polygonalis*, Duchassaing, Rev. Zool. Antilles,

p. 30.

1902. *Astroria polygonalis*, Vaughan, Quart. Jour. Geol. Soc.

London, Vol. LVII, p. 497.

Original description:

"Walls bearing a very small proportion to the size of the corallite (in transverse section). Calices polygonal, varying in size; many form short series, but the simple corallite is in excess. Columella very rudimentary. Septa long, thin, alternately large and small; they are generally numerous, but in a small coral-



*Astrorria polygonalis*

lite they are few, and resemble those of an *Astrorea* with a low septal number. A small undeveloped corallite gives six systems, two cycles in some and three in other systems. Length of each series 9 1/2 lines; three septa to 1/10 inch; the width varies, from the ends of the series being pointed. Width of the largest corallites not forming series 1/2 inch, of the smallest 1/4 inch. Endotheca abundant and subvesicular.

From the Chert-formation of Antigua. Coll. Geol. Soc.

The lithological character of this specimen is very interesting, the interspaces being filled with opalescent and opaque-white silica."



*Phrygia cleviei* sp. nov.

Pl. , fig.

Corallum of type specimen small, 25 mm. long; 19 mm. wide; 17 mm. tall. Upper surface irregularly rounded. Corailites deformed. Calices, subcircular, short-elliptical, elongate elliptical, ovoid, or dumb-bell shaped, moderately deep. A subcircular calice is 3.5 mm. in diameter; an elongate one is 6.5 mm. long, 3.5 mm. wide. Falicular margins somewhat elevated. Thickness of wall between calices, 1.3 to 2 mm.

Septa about 48 in number in the largest calices in which fission has not yet commenced; usually three complete cycles with half or more than half the members of the fourth. They are rather thick, thicker in the wall. Every other or every fourth one reaches the columella, the intervening ones vary in size according to cycle. The outer ends of the septa are continued as low, equal, rather thick costae across the top of the wall.



The inner ends fuse together laterally and by trabeculae processes, forming a well developed columella. Apparently pali, or paliform lobes are present -- septal thickenings correspond in position to pali. Both exothecal and endothecal dissepi-ments present.

The margins of both septa and costae are worn, the denticulations thus being destroyed.

Locality: Island of St. Bartholomew, West Indies, P. T. Cleve, Collector.

Geologic horizon:

Type: University of Upsala.

Remarks: This species is so close to *Favia fragum* (Esper), Pleistocene and recent, that it is doubtful if really valid differences can be pointed out, when the type specimen of *F. clevei* is imperfectly preserved. There is no difference in the form and size of the corallum, shape and size, and distance apart of the calices, or in the number and arrangement of the septa. Apparently in *F. clevei* the margin of the calice is



more abruptly elevated than in *F. fragum*. The intercostal furrows in the former appear relatively deeper, and not infrequently exothecal dissepiments can be seen in them. These two are the only differential characters that I could discover. However, perfect specimens might show differences in ventral and costal dentations and in the character of the pali.

The diagnosis of *F. clevei* is admittedly not satisfactory, but the specimen upon which it is based is important, as it shows that the *Favia fragum* group existed in the West Indies as far back as Eocene or Lower Oligocene time.



*Favia Bartholomaei*, sp. nov.

Pl. , fig.

Corallum depressed, flattish with humps on the upper surface. Horizontal extension exceeds the thickness. The largest specimen is 7.3 mm. across and 3.2 mm. thick.

Corallites irregularly polygonal. Calices, shallow, ranging in diameter from 3 to 5.5 mm.; separated by walls from .5 to 1.5 mm. across -- in one instance the wall is 2 mm. thick.

Septa quite thick, especially at the wall, the number from 19 to 27, at least half of which reach the columella, in the larger calices all of them may do so. The outer septal ends form equal, thick, low costae across the top of the wall, the inner ends fuse quite solidly to form a large compact columella, which occupies about one-half of the corallite cavity.

Details of the endotheca not recognizable.

Locality: Island of St. Bartholomew, West Indies, P. T.



*Favia bartholomaei*,

Cleve, Collector.

Geologic horizon:

Type: University of Upsala.



Genus LAMELLASTRAEA Duncan.

1867. Lamellastraea, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIV, p. 19.

1884. Lamellastraea, Duncan, Jour. Linn. Soc. Zool., Vol. XXIII,  
p. 102.

Type species of the Genus: Lamellastraea smythi Duncan.

Original description:

"The corallum is compound; the corallites are united by their walls, and are more or less polygonal in transverse outline; the columella is essential and lamellar; the septa are alternately large and small; and the reproduction is principally by fissiparity through the solid columella, and occasionally by marginal gemmation."



*Lamellastraea smythi* Duncan.

Pl. fig.

1867. *Lamellastraea smythi*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, pp. 20, 24, Pl. I, figs. 2 a, 2 b.

Non.

1895. *Lamellastraea smythi*, Gregory, Quart. Jour. Geol. Soc.

London, Vol. LI, p. 209.

Original description:

"The corallum is large and massive. The corallites vary in size, from their undergoing fissiparous division. The walls are solid and delicate. The septa are short, alternately large and very small, although a small septum often separates two smaller. The larger septa are broadest at the wall, and have a paliform tooth near the columella, and they reach further inwards than the smaller septa. The smaller septa are linear. The columella is stout, more or less lamellar, and a portion of it remains as a large septum after fissiparity. The number of



large septa varies, but in small calices twelve may be counted.

The endotheca is scanty.

Diameter of longest corallites undergoing fissiparity about  $1/5$  inch; diameter of the smallest corallites  $1/10$  inch.

Loc. Antigua, probably from the Marl (Coll. Brit. Mus.).

This genus is readily distinguished by the lamellar columella, the want of pali, and the fissiparous division. It must be classified amongst the Faviaceæ, and placed between the genera Favia and Goniastraæa."



Goniastrea variabilis Duncan.

Pl. 7 fig. 1, 2 [Types]

1873. Goniastrea variabilis, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIX, p. 557, Pl. XXI, fig. 11.

1899. Goniastrea variabilis, Vaughan, Bull. Mus. Comp. Zool.,

Vol. XXXIV, p. 229.

Duncan's original description:

"The corallum is massive, ovoid and depressed in shape;

and the corallites radiate from a small base.

The upper surface is slightly convex, and is crowded with calices of different sizes, and all more or less angular in outline.

The walls are thin, united, and slightly wavy.

The fossae are shallow; and the columella differ greatly in their development. Usually they are spongy and well developed; sometimes they are distinctly linear, and formed by one lamella;



and in some young corallites the columella barely exists.

The septa are alternately thick and very slender; they are short and wide apart; they are few in number, and are without distinct cyclical order.

There are some calices with 12, and others with septa reaching to 40 in number, and many intermediate sizes.

Fissiparity is frequently observed.

Height of the corallum 1 3/10 inch. Length 3 inches.  
Breadth 2 1/4 inches. The long axis of calices from 2/10 to 3/10  
inch.

Loc. ---The conglomerate of St. Bartholomew's.

In the collection of Mr. P. T. Cleve, Stockholm.

The nearest species with which this can be associated is Goniastrea solidia, Edw. & H., which is found in the recent fauna of the Red Sea and the Seychelles, and which forms part of the raised reefs of the Arabian shore of the Red Sea.



The lamellar condition of the columnella in some coralites is very interesting, and foreshadows the genus Lamellastraea (Duncan, Foss. Corals West Indies, part iv, p. 20, Quart. Journ. Geol. Soc. vol. xxiv (1868). "



Favoidea junghuhni Reuss Duncan.

Pl. fig.

1867. Favoidea junghuhni, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIV, pp. 20, 24.

Duncan makes the following remarks:

"A specimen of the genus Favoidea of Reuss (Ueber fossile  
Korallen von der Insel Java, p. 168) presents corallites slightly  
larger than the type, and the septa appear slightly larger at the  
wall; but there is no specific difference between the type and  
the specimen which I found in the collection of West-Indian fossil  
corals in the British Museum and whose mineralization would lead me  
to believe was Antiguan. The type is from the Miocene (?) of  
Java, whose corals have been so ably described by Reuss."



*Leptoria profunda* Duncan.

Pl. fig.

1873. *Leptoria profunda*, Duncan, Quart. Journ. Geol. Soc. London, Vol. XXIX, p. 555, Pl. XX, fig. 8.
1899. *Leptoria profunda*, Vaughan, Bull. Mus. Comp. Zool., Vol. XXXIV, p. 229.

Original description:

"The "collines" are thick; and the series of undistinguishable calices is long and deep, but wide centrally.

The septa are crowded, curved, and mostly very thick and well developed; and there are 16 in 5/10 inch.

The columella is thin, but distinctly lamellar.

Greatest depth of series 1 6/10 inch. Breadth 9/10 inch.

In the collection of Mr. P. T. Cleve, Stockholm.

Loc. --In the limestone of St. Bartholomew's, West Indies.

The genus is represented in the Oberburg Eocene Coral-fauna, in the Lower Chalk of Gosau, Piësting and Bains de Rennes; and the recent forms are in the Pacific, Indian Ocean, and Ceylon seas.



*Manicina bartolomaei* sp. nov.

Pl. , fig.

1873. *Manicina areolata*, Duncan (non Linn.), Quart. Jour. Geol.

Soc. London, vol. xxix, p. 555.

1899. *Manicina areolata*, Vaughan, Bull. Mus. Comp. Zool., vol.

xxxiv, p. 229.

Corallum small, greater diameter in one direction 33.5 mm.,  
in the other, 31 mm.; height, 24 mm. Wall strongly infolded,  
folds not fusing, not even joined by costae. Costae thick,  
equal or alternating in size, intercostal spaces narrow with  
perpendicular sides. The edges of the costae are worn, there-  
fore their character can not be determined.



Hillia bartolomaei, sp.nov.

Pl. , figs.

1873. Ulophyllia macrogyra, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 555. (not Reuss,

18 ).

1890. Ulophyllia macrogyra, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 229.

Corallum composed of long, serpentine valleys, 5.5 to 11 mm. in width, separated by very narrow simple walls. The type is a piece of a corallum, it is 75 mm. tall, 34 mm. long and 47 mm. wide; a perfect specimen probably would be quite large.

The septa are thin, long, and crowded, they are thickened in the wall, and their inner portions are gradually swollen, the inner ends apparently are furnished with a small upright tooth. Number to the centimeter, about 18, usually equal in size along the straight portions of the valleys, in the curves at the ends of the valleys alternations of shorter and longer may be quite



regular. Endotheca well developed.

Columella absent or, if present at all, very rudimentary.

In some instances opposed septa fuse directly across the axis, but there is no lateral fusion nor are there any septal trabeculae given off along the axis.

Locality: Island of St. Bartholomew, West Indies, P. T.

Cleve, Collector.

Horizon:

Type: University of Upsala.



~~Hillia portoricensis~~

Hillia portoricensis sp. nov.

Pl. , figs.

Corallum massive, composed of long valleys, from 5.5 to 9 mm. wide, and about 3.5 mm. deep, separated by acute collines. Walls in the collines, rather thick but simple.

Septa, rather thick, crowded, about 100 in 5 cm., or 20 to the cm. Usually alternately shorter and longer, but in some places they are equal. At the wall usually equal in thickness. The inner ends of some septa are enlarged, and there are indications that such septa bear upright paliform teeth. Margins dentate. Calicinal centers indistinct.

Columella absent.

Locality: 4 miles west of Lares, Porto Rico, R. T.

Hill, Collector.

Geologic horizon: Upper Oligocene, Pepino formation.

Type: No. , United States National Museum.



Remarks:

portoricensis is very close

to bartolomaei. The difference seems to lie  
in the former having straighter valleys (a character of very  
little value), thicker septa and walls.



*Coeloria dens-elephantis* Duncan.

Pl. figs.

1863. *Coeloria dens-elephantis*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XIX, p. 424, Pl. XIV, fig. 8.

1866. *Coeloria dens-elephantis*, Duchassaing & Michelotti, Sup.

Mem. Corall. Antilles, p. 82 (of reprint).

1867. *Coeloria dens-elephantis*, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XXIV, p. 24.

1870. *Coeloria dens-elephantis*, Duchassaing, Rev. Zooph. Antilles,

p. 30.

Original description:

"Valleys long, very much disposed to be nearly straight, branching rarely, and then at an acute angle, parallel, varying greatly in width. The resemblance of transverse sections to the dental laminae of Elephas is most remarkable. Length 1 inch; breadth from 2 to 3 lines. A columella is present as a few laminae, occasionally continuous with the septa. Septa alternate-



ly thick and thin, without pali or transverse enlargement, four or five to 1/10 inch. Endotheca abundant and at right angles to the septa. The mural elevations, so far as can be judged from a section, are small and delicate.

The specimen is an example of the variety of siliceous fossilization where the interspaces are filled with porcellanous and opaline silica, the selerenchyma having lost much of its details and being turned into homogeneous dark flint.

From the Chert-formation of Antigua. Coll. Geol. Soc."



*Syzympellia* sp.



*Sympyllia anguillensis* sp. nov.

Pl. , fig.

Corallum with an undulate, subhorizontal base, and a gently scalloped margin. Height, 40 mm.; length, 96 mm.; width, 93 mm.

The base is covered by an incomplete epitheca that extends to its edge. Below the epitheca, not always covered by it, are numerous low, equal or subequal, narrow, serrately dentate costae. There are from 8 to 12 costae to the cm., the coarse costae having coarser dentations.

The upper surface presents wide rather shallow valleys, which throw off lateral lobes, and are separated by simple collines -- if double walls occur at all in the collines they are rare. Width of valleys 12 to 22 mm.; depth, 3.5 to 7 mm.; width of top of arch of collines 3 to 5 mm.



Septa in general thin and distant, thicker over the arches of the collines. The number to the cm. is 8 to 12, the same as for the costae. There are no clearly distinguishable cycles, the septa are subequal or alternate irregularly in size. The interseptal loculi are usually about twice the width of the septa. The septal margins are quite regularly serrately dentate, about as in Kaeandra (Manicina) areolata (Linn.).

Endothecal dissepiments well developed, thin; exotheca present.

Columella poorly developed, all but absent, formed by the very loose junction of processes from the ends of a few septa. The calicular centers are indicated by the direction of the septa and the lateral lobes of the valleys.

Locality: Island of Anguilla, West Indies, P. T.  
Cleve, Collector.

Geologic horizon: Upper Oligocene.

Type: University of Upsala.



Remarks: This coral in general appearance bears a striking resemblance to Raeandra areolata, but the columella is very different, that structure in the latter species being highly developed and spongy. Although the septal dentations are very fine for a Symphyllia, I have placed it in that genus because of agreement in its other characters.



Mussa (Symphyllia).

Pl. fig.

1901. Symphyllia sp. nov., Vaughan, Quart. Jour. Geol. Soc.

London, Vol. LVII, p. 497.

(Description to be written later).

Locality.---Antigua, West Indies (J. W. Spencer, Collector).

Geologic horizon.---Upper Oligocene.

Type. ---United States National Museum.



*Confusa* (*Duncan*)  
*Siderastrea portoricensis* sp. nov.

Pl. , figs.

Corallum massive, rounded above, basal portion somewhat expanded. Greater diameter of base, 106 mm.; lesser, about 65 mm.; height, 65 mm.

Calices, polygonal, quite large, diameter (measured from summit to summit of wall) from 4.7 to 6.5 mm., 5 to 6 mm. the usual diameter. Near the edges the calices are shallow, higher upon the corallum excavated and moderately deep. The outer ends of the septa are arched on the upper part of the corallum, may be somewhat flattened near the wall; lower down they may be depressed across quite a wide area, with a very shallow calicular cavity; in a few instances a depression corresponds in position to the upper edge of the wall. The wall is merely a zone of synapticula.

Septa very crowded, thin and numerous, from 60 to more than 70. They are so crowded that it is difficult to make out



the cycles. The primaries appear to be free, the other septa form groups around the secondaries. Septal margins finely beaded. *Synapticula* abundant.

Columella not greatly developed. Upper surface finely papillose.

Locality: 4 miles west of Lares, Porto Rico, R. T. Hill, Collector.

Geologic horizon: Upper Oligocene, Pepino formation.

Type: No. , United States National Museum.



*Isastraea conferta* Duncan.

Pl. fig.

1863. *Isastraea conferta*, Duncan, Quart. Jour. Geol. Soc. London,

Vol. XIX, p. 422, Pl. XIV, fig. 2.

1867. *Isastraea conferta*, Duncan, Quart. Jour. Geol. Soc. London,

Vol. XXIV, p. 25.

Original description:

"Corallites very close, tall, slender, straight, and prismatic; a transverse section shows the wall to be very thin. The breadth of the corallites varies from  $\frac{3}{10}$  to  $\frac{1}{10}$  inch. Septa very numerous, linear; the primary extend to the centre of the corallite, the secondary less so, and the others join the larger septa at a very acute angle; all are very slender and excessively crowded. There are eighty-two septa in the larger corallites, sixty in the smaller. The septa of one corallite do not join those of the next, but end sharply at the wall. Endotheca plainly exists, linear, appearing, in transverse section, to divide

5mm to 2.5mm.



*Isastrea conferta*

the interseptal loculi into several cells. The reproduction is by submarginal budding. The sclerenchyma has been replaced by dark homogeneous silica, and the interspaces by porcellanous and opaline silica.

From the Chert-formation of Antigua. Geol. Soc.

This is a very remarkable form. Unfortunately no calices exist; but the transverse view of the corallites is excellent. If the specimen had been found in Oölitic rocks, it would have passed for a small variety of Isastraea tenuistriata."



*Isastrea turbinata* Duncan.

Pl. figs.

1863. *Isastraea turbinata*, Duncan, Quart. Jour. Geol. Soc. London,

Vol. XIX, p. 423, Pl. XIV, figs. 1 a - 1 c.

1866. *Isastraea turbinata*, Duchassaing & Michelotti, Sup. Mem.

Corall. Antilles, p. 89 (of reprint).

1867. *Isastraea turbinata*, Duncan, Quart. Jour. Geol. Soc. London,

Vol. XXIV, p. 25.

1870. *Isastraea turbinata*, Duchassaing, Rev. Zooph. Antilles,

p. 31.

Original description:

"Corallum 7 inches high, subplane and irregularly convex above, broad and gibbous at the sides, small and conical at the base, whence the corallites radiate; upper surface ridged with the elevated margins of more or less polygonal, close calices. Corallites very long, slender, and prismatic, excessively crowded. Walls united, simple throughout. Calices very numerous, ir-



regularly pentagonal, not deep, and not packed geometrically. Margins existing as sharp ridges, not marked by the septa, but faintly ragged; united, crowded, not deep. Septa small, not exsert, not arched, but slanting irregularly downwards and inwards, except the primary, which stand up in the fossa, and are easily seen; they are laminar, delicate, and crowded, slightly toothed near the internal end, ragged above, and granular on the sides. The primary septa sometimes meet by their inner ends; the secondary and tertiary are subequal when there are others. They are disposed in six systems. In fully developed calices there are four cycles in four systems, and three in the rest; in other calices three cycles with an occasional fourth order; the fourth cycle is very small. Septa straight, not crenulate, but slightly ragged; no external spines. Endotheca tolerably developed. From the condition of the base, which has been rolled, no epitheca can be seen. Reproduction by submarginal (close to the wall) gemmation. Diameter of the calices from 2 lines to 3 1/2 lines.



*Isastrea turbinata*

From the Chert-formation of Antigua. Coll. Geol. Soc.

Fossilization very like that of Isastraea oblonga in the British Portland Oolite.

The affinities of these two Corals with the Isastraea are not to be mistaken; and their occurring in the Chert of Antigua, where they are associated with the Miocene Astrocoenia ornata, is very remarkable."



*Isastrea confusa* Duncan.

Pl. figs.

1867. *Isastraea confusa*, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIV, pp. 14, 24, Pl. II, fig. 6.

Original description:

"The corallum is short, and covers much space. The coral-lites are very irregular in size, and the calices also. The fossa is moderately deep, and presents a false columella. The septa are thick, and unite laterally in sets of three, four, or six. The free margin is faintly dentate. The largest calices have four cycles of septa in six systems; but usually only three cycles are found in smaller calices. The diameter of the calices is from 1/10 to 4/10 inch.

Locality. St. Croix, Trinidad."



*Agaricia portoricensis* sp.nov.

Pl. , fig.

Corallum forming a rather thick unifacial frond. The type specimen is a fragment and does not give a definite idea of the size to which the corallum grows. It is 45 mm. long, of the same width, and 5.5 mm. thick. The back is without calices, is naked ~~and~~ <sup>porosus</sup> and finely costate, about 23 costae to 1 cm., <sup>which</sup> ~~the~~ costae are subequal in size, alternately larger and smaller, or every fourth may be slightly larger than those intervening. The edges ~~are~~ narrower than the bases and <sup>are</sup> finely beaded. Intercostal furrows of about the same width as the costae.

Calices not very definitely arranged, occurring in clusters or in irregular transverse series. Considerable areas are without calices. Each <sup>calice</sup> surrounded by from 6 to 9 prominent septo-costae, as tall as 2 mm., and 1 mm. thick. Between these, on the upper (distal) side, quite often, there are smaller ones. New calices may originate by budding from the costate area. Diameter of fully developed calices, about 4 mm. The septo-costae in



the non-caliculate areas are coarse, quite prominent and equal.

Number to the centimeter, 10; height as much as 1 mm.; thickness of base, as much as .7 mm. Edges rather acute and beaded.

Intercostal furrows usually narrower than the costae. Synaptila present.

Columella slightly developed.

Locality: 4 mm. west of Lares, Porto Rico, R. T. Hill,  
Collector.

Geologic horizon: Upper Oligocene, Pepino formation.

Type: No. , United States National Museum.



*Agaricia anguillensis* sp. nov.

Pl. , figs.

Corallum rather low, consisting of crissate, divided and lobed fronds. Height or extension from the center, 44+ mm. Thickness 3 to 4 mm., thinner on the edges.

Calices unifacial subconcentrically arranged, mother calice excentric. In the type specimen, the distance from the mother calice to the edge of the frond is 35 mm., with five rows of calices, the outermost calice 6 mm. from the margin, making 7 mm. the average distance between the rows, the distance varies from 5 or 6 to 9 mm. The lower side of the rows is very slightly swollen, the ridges are almost suppressed. Transverse diameter of calices 3 to 7 mm. On the upper side the septa-costae directly continuous without elevation to the next series. Under sides of frond finely striate.

The septa vary in number from 15 to 38, alternately larger and smaller or arranged in three cycles. 6 to 12 septa



*A. anguillensis*

are decidedly larger and thicker than the others. The septa-costae are solid and coarse, especially every other one, with an intervening smaller one. Synapticula quite abundant.

Calicular fossa not deep. Columella papillary.

Locality: Island of Anguilla, West Indies, P. T. Cleve,  
Collector.

Geologic Horizon: Upper Oligocene.

Type: University of Upsala.



*Oroseris antiguensis*, sp. nov.

Pl. fig.

1901. Oroseris sp. nov., Vaughan, Quart. Jour. Geol. Soc. London,  
Vol. LVII, p. 497.

(Description to be written later).

Locality.---Antigua, West Indies.

Geologic horizon.---Upper Oligocene. "The White Limestone  
or Antigua Formation" of J. W. Spencer.

Type.---United States National Museum.

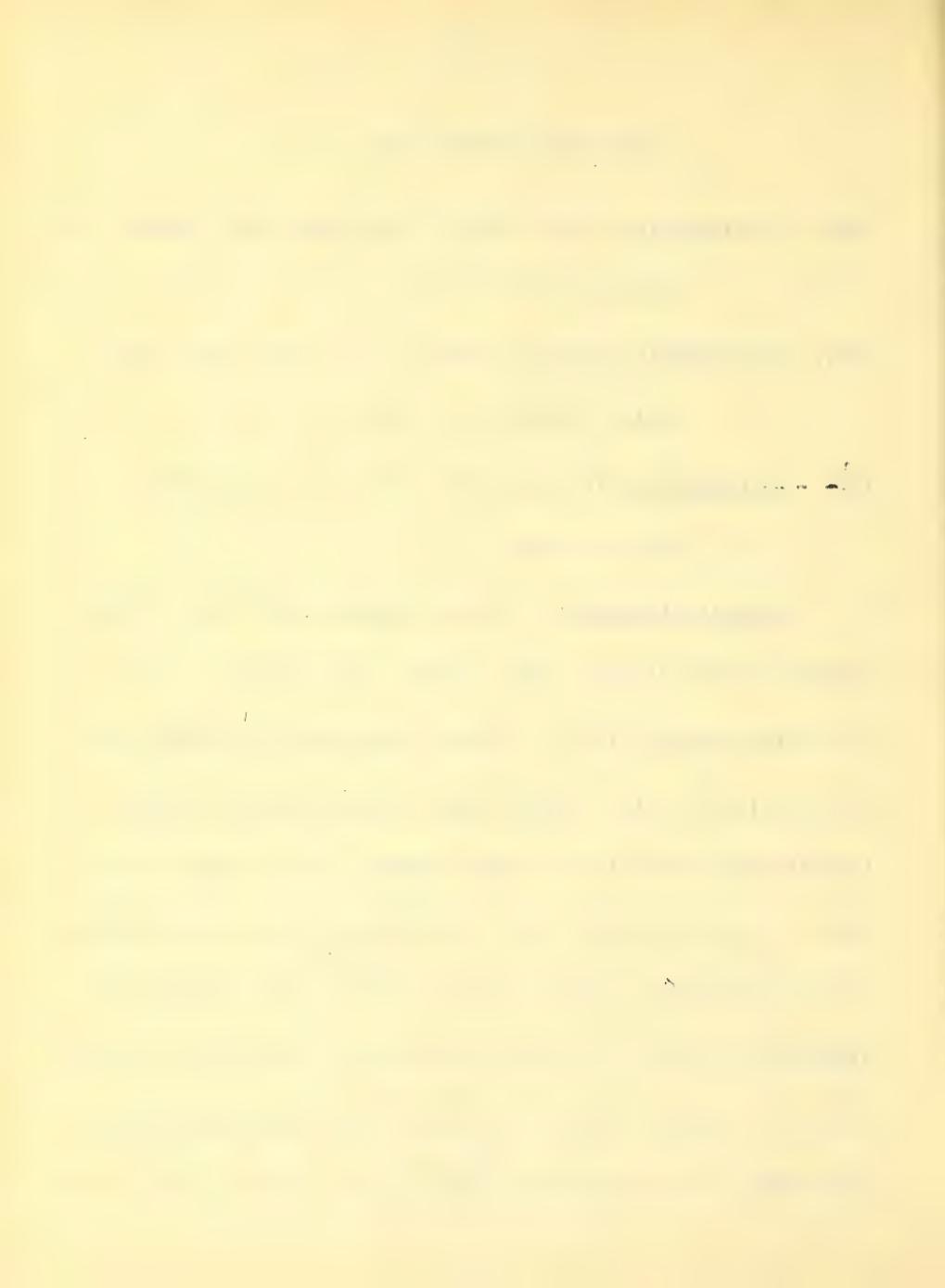


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Genus ANTILOSERIS nov.

1873. Turbino-seris, Duncan, Quart. Jour. Geol. Soc. London, vol. xxxix, p. 558.
1884. Turbino-seris (Partim), Duncan, Jour. Linn. Soc. London, Zool., vol. xviii, p. 148.
1899. Turbino-seris, Vaughan, Bull. Mus. Comp. Zool., vol. xxxiv, p. 243.

Generic diagnosis: Corallum simple, cuneiform, or depressed, may be discoid, base narrow. No epitheca. Wall perforate, synapticulate. Costae present as the distal terminations of the septa. Septa solid, septal margins dentate (dentations rounded in the type species), septal faces granulate. In cross-section, the granulations usually are directed inward and hooked. Synapticula out of the thecal ring rare; dissepsiments appear to be entirely absent. Columella, strictly speaking, absent. When the more perfect calices are viewed from above, a narrow furrow is seen to occur in the axis; a thin



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section shows that lower down in the corallum the inner ends of opposed longer septa fuse directly across the axis; lateral fusion of the inner septal ends may, or may not, be complete in the axis.

Type species: Turbinoseris eccaenica Duncan (= T. ecae-  
nia D. + T. major D. + T. grandis D. + T. antillarum D.),  
Quart. Jour. Geol. Soc. London, vol. xxix, p. 558, pl. xxi, figs.  
12, 12a-12c; also pp. 559, 560, pl. xxi, figs. 13, 13a, 14, 14a,  
16, 16a.

Distribution: Older Tertiaries of the Antilles.

Remarks: Duncan referred the corals for which I am proposing Antilloseris to his Turbinoseris, but it seems probable

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✓ For a discussion, cf. p. <sup>E</sup> in infra, this paper.

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that Turbinoseris is a synonym of Leptophyllia Reuss. As will be pointed out later, Turbinoseris has never been properly defined (infra, p. ). Rather than leave the West Indies



species in the uncertain state in which they have been for many years I have erected a new genus for them.

Antilloseris is very closely related to Podoseris Duncan. The former differ from the latter, (1) by being devoid of epitheca, (2) by the absence of dissepsiments, (3) by the absence of a columella. Podoseris appears to possess a small, but papillate columella.



1899. Turbinoseris grandis, Vaughan, Bull. Mus. Comp. Zool.,  
vol. xxxiv, p. 229.

1899. Turbinoseris antillarum, Vaughan, Bull. Mus. Comp. Zool.,  
vol. xxxiv, p. 219.

Original description of Turbinoseris cocaenica:

"The corallum is tall and greatly compressed. At the base there is a sharp peduncle, from which the sides pass rather abruptly outwards and upwards at first, and then they diverge but slightly to the calice. The shape is that of a narrow and compressed cone.

The calice is elliptical in outline; and its margins are either horizontal or slightly arched in the direction of its long axis. It is shallow; and there is no columella. In its long axis there is a linear space, which is bounded by the enlarged ends of the larger septa.



The septa are very numerous, crowded, unequal; and the smaller frequently join the larger by their sides.

There are five complete cycles of septa in six systems; and there are a few laminae of the sixth cycle. The larger septa reach and form the horizontal floor of the calice; and their ends are swollen, and bound the axial space. Numerous and delicate synapticulae join the septa.

The costae are delicate, subequal, very numerous, close, wavy occasionally, and are connected by numerous well-developed synapticulae, which are placed very closely.

The costal and septal numbers were attained very early in the life of the coral.

The epitheca is rudimentary, and barely exists.

The wall is thick.

Inferiorly, the tissues around the peduncle are usually worn off.



(a)

Height of full-grown specimen, 25 mm. Length of calice  
18 mm. Breadth 10-13 mm.

The immature specimens of this species resemble the lower  
half of the full-grown, and are compressed and wedge-shaped."

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(a )

Duncan's measurements given originally in fractions of  
an inch are transmuted into millimeters.

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Original description of Turbincseris major:

"The corallum is pedunculate, tall, narrow, conical, and compressed.

The calice is elliptical in outline and deep.

The septa are slightly exsert, crowded, alternately large and small, and they pass down deeply into the fossa.

Their laminae diminish in size from the margin inwards.

There are five cycles of septa in six systems.

The synapticulae are scanty.

The costae are delicate, close, subequal, and the larger are flat and faintly granular. All are connected by numerous horizontal and sometimes oblique synapticulae.

The wall is very thick. Epitheca quite rudimentary.

"Height 33 mm. Length of calice 23 mm. Breadth 15 mm."



Original description of Turbinoseris grandis:

"The corallum is short, very broad, and compressed, and has a sharp peduncle.

The calice is elliptical in outline; and its margin is not quite horizontal, but is thick.

The fossa is shallow.

The septa are numerous, crowded, alternately large and small, and the larger end internally with swollen terminations along an axial space. There are five cycles, and a few septa of the sixth, in six systems. All are joined by numerous synapticulae and the smaller septa join the larger occasionally.

The costae are subequal, broad, close, and swollen at the junction of the numerous synapticulae.

The epitheca exists in some specimens.

Usually the wall is much worn around the peduncle.

Height of corallum 23 mm. Length of calice 28 mm. Breadth 18 mm."



Original description of Turbinoseris antillarum:

"The corallum is turbinate and compressed. It has a sharp peduncle.

The calice is elliptical in outline, very shallow and open.

The septa are numerous, long, thin, and curved. The shorter join the longer not far from the centre; and these pass inwards thus increased in size.

The costae are equal, longer than the septa, and smaller inferiorly than at the calicular margin.

The synapticulae are not abundant. The esitheca is banded.

Height of corallum 33 mm. Length of calice 25.5 mm.

Preadth 20 mm.



A careful comparison of the descriptions of Duncan's so-called species will not reveal any important characters by which they can be separated. A study of about 70 specimens, including the types, belonging to the University of Upsala, has shown that it is simply impossible to separate the specimens as Duncan did.

It does not seem necessary to redescribe the general appearance, &c., of the specimens, as Duncan's descriptions are sufficient. The type of T. grandis has a much corroded base, and its calice is longer than is usual in the other specimens.

The corallum wall is synapticulate and perforate; the septa are imperforate; and there is no columella.

Locality: Island of St. Bartholomew, West Indies, P. T. Cleve, Collector.

Geologic horizon: Oligocene, "Limestone of St. Bartholomew."

Types: University of Upsala.



*Antilloseris angulata* Duncan.

Pl. ,figs.

1873. Turbinoseris angulata, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 559, pl. xxii,

fig. 15, 15a.

1899. Turbinoseris angulata, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 229.

Original description:

"The corallum is short, turbinate, compressed, and finely pedunculate.

The calice is widely open, very shallow and elliptical in outline; and the margins are somewhat angular, especially at the long axis.

The septa are excessively thin and long, and correspond to larger costae. There are five cycles, and some of the sixth, in six systems.



The costae are close, unequal, transversely granular, and those at the end of the long axis of the calice are the most prominent and broadest. Inferiorly synapticulae exist.

Epitheca rudimentary.

Height of corallum 13 mm. Length of calice 33 mm.  
Breadth 23 mm.

The following measurements are based on 9 specimens belonging to the University of Upsala:



Specimen	Greater diameter of calice.	Lesser diameter of calice.	Weight of corallum	Remarks.
1	22 mm.	18 mm.	14 gm.	
2	21	20	16	
3		23	16	One end of calice broken
4		22	ca 14	" " " " "
5	33	22	24+	calice medially constricted.
6	28	21	ca 18	
7	31+	20	22	
8	30	23	13	Type, slight median constriction.
9	32	23	16	Type

The measurements indicate considerable variation in form, especially in the amount of compression of the calice. Synapticula are very abundant between the costae near the base, and they are quite abundant near the margin of the calice. In the intermediate area the wall is almost or entirely solid. The costae are not prominent, are relatively wide, the intercostal furrows narrow, every other or every fourth one more prominent.



The number of the septa is as Duncan has given it. Pl. [fig. , represents an enlarged thin section of a portion of a corallum. Except in the wall and near the inner ends of some septa synapticula appear to be absent.

Columella absent.

Locality: Island of St. Bartholomew, West Indies, P. T. Cleve, Collector.

Geologic horizon: Oligocene, "Limestone of St. Bartholomew."

Types: University of Upsala.



*Antilloseris cyclolites* Duncan.

Pl. , fig.

1873. *Turbinoseris cyclolites*, Duncan, Quart. Jour. Geol. Soc.

London, vol. xxix, p. 560, pl. xxii,

figs. 18, 18a, 18b.

1899. *Turbinoseris cyclolites*, Vaughan, Bull. Mus. Comp. Zool.,

vol. xxxiv, p. 230.

Original description:

"The corallum is very short, has a widely open calice, a small mamilliform peduncle, and an almost horizontal wall.

The calice is elliptical, and has a central fossa.

The septa are small and crowded.

The costae are distinct, mamilliform here and there; and some are larger than the others.

Height of corallum 7.5 mm. Breadth of calice 20.5 mm.

The resemblance of this form to one of the genus Palaeo-



Antilloseris cyclorites.

cyclus is most remarkable. There are no tabulae, however; and I have already shown that this Paleozoic group of forms should be classified under the Cyathophyllidae."

Locality: Island of St. Bartholomew, West Indies, P. T. Cleve, Collector.

Geologic horizon: Oligocene, "Limestone of St. Bartholomew."

Type: University of Upsala.

This species is closely related to Antilloseris angulata, in fact it looks as if it might be only cyclolitoid form of that species.



7. *GORGONAE PHYSOCOTYPS* nov.

1873. *Trochoemilia*, Duncan, Quart. Jour. Geol. Soc. London, vol. xxix, p. 552, pl. xix, figs. 2, 2a, 3, (not *Trochosmilia* Milne Edwards & Haime).

Generic diagnosis: Corallum simple, subcylindrical or compressed. Epitheca entirely absent or rudimentary. Wall ~~solid~~, composed of pseudothecal thickenings of the septa, or of dissepiments; it is mostly dissepimental. In fact the dissepiments are so arranged as to give the appearance of an imperforate wall in many if not most cases. Costae present, representing the peripheral ends of the septa. The costae rather prominent and distant, with rather definite girdling exothecal rings, the dissepiments in these rings extending to the costal ends. Between the rings thinner dissepiments can often be seen. Septa irregularly perforate, the first and second cycles thicker and not so perforate as the higher cycles, but they nevertheless show distinct perforations; in three polished sections I found



10. 25  
C-18

about three thicker septa that seemed to be imperforate. The septa of the higher cycles are thinner and more perforate. There is no regularity in the perforations -- they may exist near the columella, in the median portion of a septum or near the peripheral (costal) ends. A longitudinal section shows that the trabeculae may be interrupted. The septal pores do not fill up near the base, probably due to the highly developed dissepsiments cutting off the base of the corallum from the soft parts of the polyp. There is a tendency, but not a very striking one, to form septal groups. Synapticula scarce, present near the base, and probably also present near the inner ends of the septa. Dissepiments well developed, curving outward, one set above another. In a cross section of a corallum they show as several definite rings -- usually three or four rings occur between the columella and the peripheral or mural zone. Columella distinctly developed, shows in transverse section as a number of axial trabeculae, which may be more or less fused among one another,



and to the inner ends of the septa. Its upper surface is probably, though not positively, papillate.

Type species: Trochosmilia insignis Duncan (= T. insignis D. + T. arguta Duncan (non Reuss), Quart. Jour. Geol. Soc. London, vol. xxix, p. 552, pl. xix, figs. 2, 2a, and also fig. 3.

Distribution: Old Tertiaries of St. Bartholomew, West Indies.

Remarks: How Duncan ever referred his Trochosmilia insignis to Trochosmilia passes my comprehension. Prof. A. G. Hogbom of the University of Upsala has kindly loaned me Duncan's types. A large portion of the above description is based on Duncan's type specimen. I had prepared two thin sections, two polished transverse sections and one polished longitudinal section of other specimens. Duncan's type (which he had cut) shows nearly every character, given in the preceding diagnosis, that can be seen on a transverse section. His figure of the transverse section (pl. xix, fig. 2a) clearly indicates perforate



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*Physozoa,*  
*Trochosmilia insignis* Duncan.

Pl. figs.

1873. *Trochosmilia insignis*, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIX, p. 552, Pl. XIX, figs. 2, 2a.

The following is Duncan's original description:

"The corallum is tall, cylindrical above, and curved inferiorly. Superiorly it is slightly compressed, and inferiorly decidedly so, close to the broad scar of the former adhesion.

Transverse sections near the calicular termination exhibit nearly circular outlines.

The wall is thin; the costae are subequal, distinct, sharp, not crowded, and they enlarge where the exotheca comes in contact with them. Near the calice rudimentary costae exist.

The septa are thinner than the costae, and are wavy. There are six systems, and five cycles in each system, the fifth



being occasionally incomplete. Septa are attached to the rudimentary costae. All the septa are connected by oblique dissepiments; and a false columella is occasionally produced by the junction of the septal ends by endotheca.

The exotheca is abundant.

Height of corallum 1 7/10 inch. Breadth of section 6/10 inch.

Loc. ---St. Bartholomew's Island, West Indies.

Collection of Mr. P. T. Cleve, Stockholm.

Var. with equal costae.



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septa. The specimen identified by Duncan as T. arguta Reuss is precisely the same thing. It also has perfectly distinct septal perforations, and there are hints of columellar papillae.

This genus, I think, is most closely related to Frechia Gregory, but can be immediately separated by its highly developed dissepiments. The genus seems to be unusually distinct from any of those previously described.

8. Genus LITHOSERIS Koby.

1886. Lithoseris, Schweiz. palaeontol. Gesellsch., Abhand., Ed. xiii, p. 338.

Generic diagnosis: "Corallum simple, more or less elevated and turbinate. Septa numerous, crowded, little compact (peu compactes), free margin divided into irregular granulations, septal faces covered with irregular granulations. Columella spongy, prominent. Epitheca complete. Pseudo-synapticula numerous. Dissepiments rare."



Trochosmilia arguta Reuss, Duncan.

Pl. figs.

1873. Trochosmilia arguta, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIX, p. 552, Pl. XIX, fig. 3.

The following are Duncan's notes:

"Some specimens from the limestone of St. Bartholomew, and  
in the collection of the University of Upsala, so closely resemble  
this species \* from the Castel-Gomberto Oligocene that I am dis-  
posed to consider them geographical varieties.

Var. with a few more costae than the type.

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\* Reuss, Denkschr. Akad. Wiss. Wien, math.-nat. Cl. Band  
xxviii, p. 140.

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Genus PROTETHMOS Gregory.

1900. Protethmos, Gregory, Jurassic Fauna of Cutch, the Corals, p. 162.

Generic diagnosis: "Ethmetidae in which the corallum is simple and short; conical, turbinate, or pedunculate. Septa perforate near the axis and near the top; granulate laterally and coarsely denticulate above; rather stout, numerous, and usually straight. Synaptisulae, scarce. Columella, parietal, spongy; well developed. Calice shallow or of medium depth."

Type species: Protethmos oldhami Gregory, op. sup. cit., p. 164, Pl. xviii, figs. 10-13.

Distribution: Jurassic of India.

Remarks: Gregory gives a lengthy discussion of the affinities of Protethmos (op. sup. cit., p. 163). It is separated from Epistretophyllum Milasch., Lithoseris Koby, (probably a synonym of the former), and Turbinoseris, by Duncan by these genera probably having imperforate septa. None of these genera is adequately described. Podoseris Duncan is said positively to have imperforate septa.

Gregory does not describe the wall, nor does he state whether epitheca is present or absent. Figures 10c and 12c (Pl. xviii) show a thick, imperforate wall - such is at least the condition below the upper edge of the calice. Epitheca appears from the figures to be absent or only vestigial.



Protethmos bartolomaei, sp. nov.

Pl. , figs. \*

1873. Trochosmilia subcurvata, Duncan, Quart. Journ. Geol. Soc.

London, vol. xxix, p. 552, pl. xix, fig.

1 (not fig. 1a.)

Duncan publishes the following:

"A variety of this species is present in the St. Bartholomew limestone; and it has a very great resemblance to the type which came from Oberburg, in Styria, and was described by Reuss in 1864." (a)

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(a) Reuss, Denkschr. Akad. Wiss. Wien, math.-nat. Cl. Band xxiii. 1864, p. 13, and Band xxviii 1868, p. 140.

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He also described a "variety" of the same species (pl. xix, fig. 1a). There are two other specimens in the collection of the University of Upsala labeled "Trochosmilia subcurvata Reuss". The four specimens certainly represent three species belonging to two different genera.



Redescription of the original of pl. xix, fig. 1(type specimen):

*Corallum cornute*, somewhat curved in plane of shorter diameter, base rather pointed, calice oblique to vertical axis, its outline almost circular. Greater diameter of calice, 20.5 mm.; lesser diameter, not quite so much; height of corallum to upper edge of calice, 33.5 mm., to lower edge of calice, 19 mm. (this side of the calice seems to have been broken, therefore the difference in height of its two sides is considerably less than these numbers indicate).

Wall with encircling constrictions and swellings; apparently solid throughout, certainly solid in its basal portion, there are occasional pits, suggesting that perforations may exist near the upper edge. Epitheca absent. Costae correspond to all septa, they are granulated, acute or rounded on the edges, their bases near together with narrow intercostal furrows. On the lower part of the corallum alternately larger and smaller, on the upper portion equal.



There are 66 septa -- four complete cycles with a little less than a third of the members of the fifth. All of the septa are thin, their distal ends, however, are enlarged. The primaries can be quite easily distinguished, partly by septal grouping and partly by their sometimes being slightly thicker than the secondaries. The primaries, secondaries and tertiaries, extend to the columella. The quaternaries are long, extend to near the columella, often fuse by their inner ends to the sides of the tertiaries; the quinaries, when present, also are quite long, often fusing to the sides of the quaternaries. The primary, secondary and tertiary septa usually are solid, the secondaries and tertiaries may show a few perforations near their inner ends; quaternaries and quinaries decidedly perforate, especially their inner portion. The septal trabeculae are not regular in size for septa of the same cycle or for the same septum. Septal faces granulate, granulations sharp-pointed, with wider bases, usually standing at right angles to the septal plane. Synapticula are present, sparse, and slender. Dissepiments apparently absent.



Columnella spongy, composed of twisted and fused continuation, of the inner ends of the septa. The upper surface of the columnella is sunken in a rather deep axial fossa.

Locality: Island of St. Bartholomew, West Indies, P. T. Cleve, Collector.

Horizon:

Type: University of Upsala.

Remarks: I have referred to this species one other specimen labeled by Duncan "Trochosmilia subcurvata", and nine others that I found in the collection. Two of these nine were used in preparing thin sections; the type specimen was cut twice and the surface was polished. Two specimens, besides the type are figured to show variation in form.



*Protethmos clevei*, sp. nov.

Pl. , fig.

1873. Trochosmilia subcurvata, var. nov. Duncan, Quart. Jour.

Geol. Soc. London, vol. xxix, p. 552,

pl. xix, fig. la,lb (not fig. 1). Not

T. subcurvata Reuss.

The following is Duncan's original characterization of the "variety."

"The corallum is subturbinate, and rather sharply conical inferiorly: its curve is slight.

"The calice is widely open; and the septa are thin, long and crowded. There are five cycles of septa, the fifth being complete in some of the six systems.

"The costae are subequal above, not very prominent, and faintly granular. Accretion-ridges are seen."

Redescription of Duncan's type for pl. xix, fig. la:

Corallum subturbinate, slightly curved in the plane of the



shorter diameter. Increase in length of diameters not constant, girdling constrictions and swellings. Greater diameter of specimen at the top (calice broken), 14 mm., lesser, 13 mm.; height, about 23 mm. (tip of base broken). The specimen is constricted at the calice, greatest diameter of corallum, a few mm. below the calice, 16.5 mm.; lesser diameter in same plane, 14 mm.

Wall costate, costae corresponding to all septa, low, equal or subequal, crowded, bases broad, edges rounded, granulate. The intercostal furrows are often pitted, in the lower portion of the corallum the pits apparently do not pierce the wall, although they may do so near its upper edge. The recrystallization of the substance of the corallum and the occurrence of crystalline calcite in the interseptal loculi render the precise determination of some details difficult or impossible. There are about sixty-two costae. Apparently no epitheca.

Septa about sixty-two in number (the number of costae), rather thick, inner ends of quite a number bound the columella. Synapticula present.



Columella rather small, apparently has a papillary termination.

Notes based on other specimens: I have referred five other specimens to this species, two of which have been used in preparing thin sections, and the upper surface of one was polished.

## Measurements.

specimen	Greater diameter of calice.	Lesser diameter of calice.	Height of corallum	Remarks.
No. 1	17.5 mm.	11.5 mm.	14.5 mm.	Base broken.
2	14.5	14	14	
3	20	13	25	Upper surface polished; base broken.

Specimen No. 1 has probably been mechanically compressed.

The costae of No. 2 are more acute than is usual. It is a perfect specimen, with a pointed and constricted calice.



The most striking external characters of the species are the low, equal or subequal costae, and the girdling constrictions and swellings. The pits between the costae are distinct.

Septa (based on three thin and one polished section).

Specimen No. 3 has about 60 costae and 65 septa. Of the septa about 30 extend to the columella, their inner joined around it by means of synapticula. These principal septa are rather thick, and are solid or very rarely perforate. The intermediate septa are shorter, much thinner and are quite abundantly perforate. Septal faces granulate. Synapticula abundant. Dissegitments apparently absent.

Columella small, but well developed, cross-section shows several flexed axial trabeculae or laths.

Locality: Island of St. Bartholomew, West Indies; P. T. Cleve, 1869, Captain A. Molander, 1872, collectors.

Geologic horizon:

Type: University of Upsala.



*Protethmos molanderi* sp. nov.

Pl. , fig.

Corallum turbinate, transverse outline broadly elliptical, slightly flattened on one side, base smaller, broken on tip. Greater diameter of calice, 18 mm.; lesser, 15 mm.; height, 17.5 mm.

Wall naked; costae distinct, corresponding to all septa, extending to the base, not especially prominent, but thick, equal in thickness but alternating in height, edges rounded and beaded. Intercostal furrows narrow, the costal faces rising abruptly from them. On the lower portion of the corallum the wall appears to be entirely imperforate, but with occasional pits; apparently there are perforations near its upper edge.

Septa, 60 in number, long and thin, all except the members of the last cycle prolonged either to or nearly to the axis, the last cycle thin and terminating the axis. <sup>near</sup> Synapticula present.

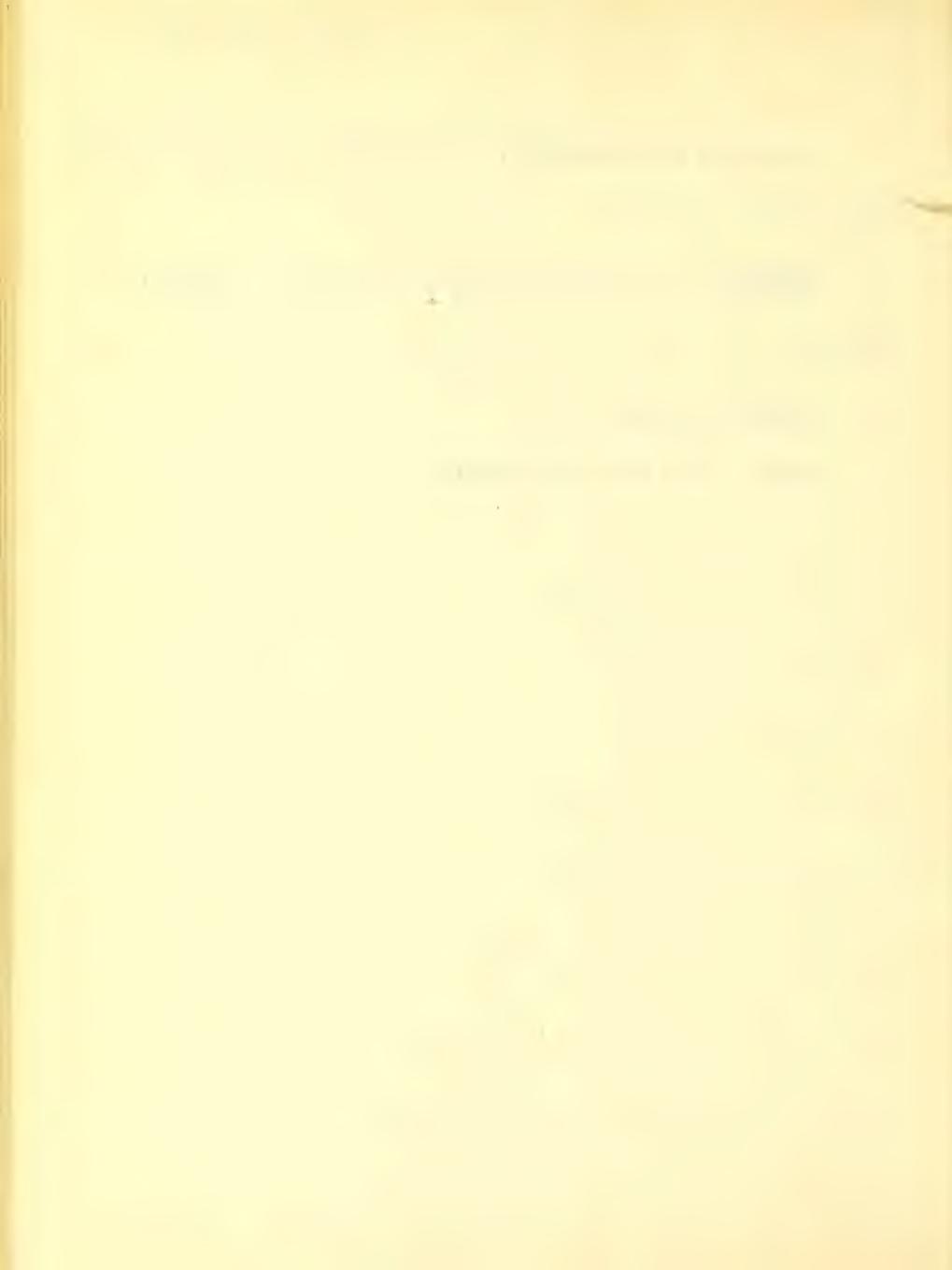


Columella very poorly developed, false. Calicular fossa rather deep.

Locality: St. Bartholomew, West Indies, P. T. Cleve, Collector.

Geologic horizon:

Type: University of Upsala.



*Protethmos gregorii* sp. nov.

Pl. , fig.

Corallum trochoid, base small, calice broadly elliptical.

Greater diameter of calice, 21 mm.; lesser, 17 mm.; height, 17.5 mm.

Specimen worn, details of the wall therefore not definitely determinable. It appears to be very largely synapticulate, with pits and some perforations. Broad, low costae corresponding to all septa.

Septa distant, in four complete cycles, primaries and secondaries thick, of equal or nearly equal size; outer ends of tertiaries thick, but thinner and shorter than the first two cycles; quaternaries shorter and thinner than the tertiaries. The primaries and secondaries are imperforate; tertiaries and quaternaries quite often disconnected in their inner portions. Septal faces but slightly granulate. Synapticula present, dissepiments appear to be well developed, occurring in the peripheral portion of the interseptal loculi.



Columella well developed, composed of numerous thin,  
flexed or curled calcareous laths, which fuse among themselves,  
and are thicker in places, suggesting a papillate upper sur-  
face.

Locality: St. Bartholomew, west Indies; Captain A.  
Mölander, Collector.

Geologic horizon:

Type: University of Upsala.



*Metethmos antillarum*, sp.nov.

Pl. , fig.

Corallium cornute, slightly curved in the plane of the shorter transverse axis, cross-section elliptical. Greater diameter of the calice, 20 mm.; lesser, 17 mm.; height, 33 mm.  
Wall worn, but shows low costae corresponding to all the septa. Intercostal furrows pitted and in some instances appear to be perforate. No epitheca.

Septa, about 64, rather thick, with the first two cycles and some tertiaries, and in some instances every other septum reaching the columella. Septal margins beaded, the lamellae are only slightly perforate. Synapticula well developed.

Columella with coarsely papillate upper surface. Calicular fossa shallow.

Locality: St. Bartholomew, West Indies, P. T. Cleave,  
Collection.

Geologic horizon:



*Genus Parastrea* Dulm Edwards & Beaufort  
*Parastrea*  
*Orbicella crassolamellata* (Duncan).

Pl. figs.

1863. Astraea crassolamellata, Duncan. Quart. Jour. Geol. Soc. London, Vol. XIX, pp. 412-417, Pl. XIII, figs. 1-7.
1866. Heliastraea crassolamellata, Duchassaing & Michelotti, Sup. Corall. Antilles, p. 86 (of reprint).
1867. Heliastraea crassolamellata, Duncan, Quart. Jour. Geol. Soc. London, Vol. XXIV, p. 24.
1870. Heliastraea crassolamellata, Duchassaing, Rev. Zooph. Antilles, p. 30.
1900. Orbicella crassolamellata, Vaughan, Science, N. S., Vol. XII, p. 874.
1902. Orbicella crassolamellata and Brachyphyllia sp., Vaughan, Quart. Jour. Geol. Soc. London, Vol. LVII, p. 497.



## Original description:

"General Description.---A group of forms from the Marl presents the following structural characteristics: -- Corallum very massive and large, with an irregular upper surface, which is convex in some parts, almost flat in others, and more or less largely gibbous in all; intercalicular groove very decided. Corallites usually very large, and never very small. Wall very delicate and indistinct; costae small; columella large. Septa variable in cyclical arrangement, the larger excessively developed at the wall and linear within. Endotheca abundant, but not in excess, vesicular. Exotheca not well developed, but decided and plentiful. Calices invariably found as casts: impressions prove them to have been shallow. Coenenchyma well developed. These characters, common to many forms, are more or less varied in intensity in different specimens. The septal number varies in individuals of the same corallum, in one series of forms to a remarkable extent, although the corallites thus differ-



ing are nearly equal in diameter, and are nearly, if not quite, as advanced in development. In other forms it is fixed to four cycles in six systems; whilst in some there are three cycles in some systems, and only two in others, the corallum being large.

The form which I consider typical of the species has four perfect cycles in six systems; but in some corallites the rudimentary sixth and seventh orders of a fifth cycle exist. The specific characteristics -- the thick and great development of the septal laminae at their wall-end, and the more or less linear, but entire, conditions of their internal parts -- are seen in all these forms, in the primary, secondary, and tertiary septa, according to the relative septal arrangements. In some corallites with a low septal number, the primary septa alone are thus characterized; and as the higher cycles are seen, so the secondary and tertiary septa become enlarged and resemble the primary. The septa of the higher orders are either linear throughout or slightly enlarged at the wall; and as they approach the tertiary or quaternary, as the case may be, they are seen to become more



equal to them in size. In examining these forms allowance must be made for their fossil condition; and attention must be given, in examining transverse sections of corallites, that they are quite at right angles to the corallite, for any obliquity will, of course, diminish the peculiar spear-shape or mace-shape of the septa, and render them more like a paddle, or a leaf with the stalk attached.

The tendency of the higher orders of septa to become linear throughout, or to be less decidedly large at one end and thin elsewhere -- that is, more or less uniformly thick, but in a less degree than is usual at the wall, -- is seen throughout the species; and in a gigantic variety, where the fully developed corallites have twelve or fourteen septa in every system, the whole of the septa are less decidedly thick at the wall, and are either more or less so throughout, or present the usual form of the septa in a modified degree.

This species is found throughout the great Marl-formation,



and presents every variety of siliceous fossilization, from that characterized by silicification of the sclerenchyma and infiltration of the interspaces by granular carbonate of lime, to that where all is siliceous and capable of polish. Destructive silicification almost invariably exists in a greater or less degree; and as the sections preserved were made, as a rule, for ornament for amusement, I have seldom seen accurately transverse and longitudinal views of the corallites.

All the specimens, with the specific peculiarities mentioned, may be ranged in seven groups; that which contains the detailed characters in their greatest intensity, generally, may be considered the typical form.

a. *Astraea crassolamellata*, typical form. Pl.XIII,figs.1a-1c.

Corallum large, irregularly convex above. Corallites tall, large, crowded here and there, but not so much so higher up or at the surface. Calices circular, but more or less elliptical when on an irregularity of the surface; very large, and separated from each other by well-marked, furrow-shaped, polygonal tracts; tracts



marked by costal elevations and by granules. Calices crateriform

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As none of the specimens exhibit perfect calices, many of these characters have, of necessity, been taken from casts.

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not much elevated above the surface. Wall thin, and rendered insignificant by the great development of the septa at the margin.

Fossa not deep. Costae numerous, and, considering the diameter of the septa at the wall, very small; they project but little, and are, as a rule, alternately large and small, not dentate, and often incline one to the other at their free edge. The larger costae present regular enlargements where the exotheca (dissepiments) of the exotheca joins them: when there are more than four cycles of septa, the smaller costae are irregular as regards their appearance and development. Columella large, of lax laminae, parietal; it does not project much at the bottom of the fossa, and occupies a large space in the corallite. Septa numerous, generally characterized by great enlargement at the wall, and linear appearance in the rest of their course, the higher orders being nearly linear at the wall also. The number



of cycles varies with the stage of development of the corallite.

Analysis of the Species.

	Intercalicular furrow.	Septa.	Cycles.	Diameter of Corallites.
O. crassolaemollata (type).	well marked	very thick at wall.	4, in some 5	3/4-4/5 inch
var. magnetica	well marked		4	12.5 mm 1/2 inch.
var. pulchella			variable	1/3-1/2 inch
var. nobilis	less well marked	very large at wall	variable	variable
var. minor		very thick at wall	2 and 3	small, va- riable
var. Nugenti	less marked			
var. magnifica	well marked	less thick and more linear	4-6	1/3 inch 1 inch and more.



In young corallites there are six systems of three cycles.

As growth proceeds, the other orders of the fourth and sometimes of the fifth cycle are gradually added. Some systems are defective in certain orders, while others possess them. The largest corallites have four perfect cycles, and a fifth in two or three systems; the ninth order being usually wanting. It is difficult, in the larger corallites, to distinguish the systems on account of the resemblance of the primary, secondary, and tertiary septa to each other.

The primary septa are very thick externally, but delicate and linear elsewhere; the linear part joins the rest suddenly, like the staff of a big-headed spear; at the junction the thick corners of the enlargement give off a lateral spine, like a piece of endotheca; near the costal end of the septa there are delicate lateral spines. The space between the sets of lateral spines is more or less square. The secondary septa are very like the primary.



When there are more orders in the system than five, that is, when there are six, seven, eight, and nine, the tertiary septa equal the primary and secondary, the blunt end terminating in the linear portion a little nearer the wall. When there are four cycles, the tertiary septa are smaller than the primary and secondary; and when there are only three cycles, as in young corallites, the tertiary septa are linear throughout. The quaternary septa are linear and very slightly developed; when there are more septa than those of the fourth cycle, the quaternary resemble small tertiary septa. The remaining septa are very small and linear, and reach a very little way from the wall; they are apt to curve towards the septa nearest them. In examining the shape of the septa in this and in all the allied forms, particular attention must be paid that the section is quite transverse, as any obliquity will more or less alter the shape of the larger end.

As regards the endotheca, the dissepiments are frequent and delicate, and not very much developed. The exotheca is tolerably well developed, but not in proportion to the size of the



corallites. Its dissepsiments form square cells. The free surface between the costae and calices has a few granules. Increase by extra-calicular gemmation.

Marl-formation of Antigua. Coll. Geol. Soc.

Measurements.---Diameter of the calices in six specimens  $\frac{3}{4}$  inch, in seven others  $\frac{4}{5}$  inch, and in some from  $\frac{1}{2}$  to  $\frac{1}{4}$  inch. The elliptical calices (situated on the sides of the corallum) are about  $1\frac{1}{10}$  inch in longest diameter. The greatest thickness of the septa at the wall is  $\frac{1}{10}$  inch. Columella  $\frac{1}{5}$  inch in diameter.

No recent specimens of this species have as yet been found, and its alliances are with Astraea Lifolensis, Edwards and Haime,\* and Astraea Cuettardi, Edwards and Haime †. The latter species

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\* Polyp. Foss. des Terr. Palaeoz., 1851, p. 98.

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† Op. cit. p. 97.

includes also the Astraea nobilis, Edwards and Haime; it has a polygonal furrow around the calices, shallow fossae, septa excessively thick at the wall, and indistinct walls. It has also



smaller corallites than the type of the new species, but larger than some of the varieties; but its costae being strong, very close, and alternately very thick and thin, constitutes a specific distinction.

A specimen of Astraea Lifolensis (Jurassic) in the British Museum has stronger resemblances to the West Indian forms than has A. Guettardi (Miocene). The general form of the fourth variety (var. nobilis) differs much from that of A. Lifolensis, although there is a great resemblance in their details. The costae furnish, however, a specific difference; still the alliance is extremely close."



*Orbicella crassolamellata* var. *magnetica*.

Pl. XIII, figs. 4 a, 4 b.

"A magnificent Astraean, resembling the typical form, but having no more than four cycles of septa. The septa are very marked, very large at the wall, and resemble the printed radii on a mariner's compass-card. Coenenchyma greatly developed. The diameter of the corallites is from 1/3 to 1/2 inch, being very variable.

Marl-formation of Antigua. Coll. Geol. Soc."



*Orbicella crassolamellata* var. *pubchella*.

"Corallum large, convex, irregular in superficial outline.

Corallites tall, varying in diameter on account of the mode of growth, rather crowded at the surface, circular in transverse section, with abundant coenenchyma. Costae wide apart. Calices rather crowded, and the intercalicular furrow not so distinct as in the typical form of the species. Diameter from  $1/3$  to  $1/2$  inch. Septa large at the margin, more or less thin elsewhere; in six systems with a very irregular septal distribution. In young corallites there are two cycles, and a third in two systems (eight large septa). In larger corallites there are three cycles in four systems, and two in the rest (ten large septa). In the largest there are three cycles in all systems but one (eleven large septa). In some large corallites a fourth cycle evidently existed near the calicular margin.

In some specimens the marginal enlargement of the septa is rendered less distinct by rather thick and not very linear septal development internally. The corallum is too large to admit of



all the corallites being badly developed, except those with four cycles; and the expression of its septal number must be three cycles, the third being occasionally wanting in some systems, and four cycles being the extreme range. The variability in the septal number is very characteristic of this variety. The exothecal disseppiments are abundant, and bifurcate here and there.

Marl-formation of Antigua. Coll. Geol. Soc."



Orbicella crassolamellata var. nobilis.

Pl. XIII, figs. 2 a, 2 b.

"Corallum large, irregularly convex, and gibbous above.

Corallites distinct, circular in transverse section, varying in size; coenenchyma well developed. Septa very large at the wall, linear within, number of large-headed septa remarkable; primary, secondary, and tertiary septa often equally large. Calices varying in size. Septal number from three to four cycles. This form is between the varieties magnetica and pulchella. Coll. Geol. Soc."



Orbicella crassolamellata var. minor.

Pl. XIII, fig. 6.

"Corallites tall, slender, crowded, distinct; walls circular, not thick. Calices circular, somewhat variable in size; the largest is 3/10 inch in diameter. The larger septa are spear-shaped, the smaller linear; they are in six systems of two cycles; rarely three cycles in two systems in some corallites. Primary septa much larger than the secondary, but nearly equaling them when there is a third cycle. Columella large.

The alternate large and small, spear-shaped and linear septa are very well seen in this form. The same details as in this form are found in several specimens with larger corallites.

Marl-formation of Antigua. Coll. Geol. Soc., and Mr. W. W. Jones's Coll."



Orbicella crassolamellata var. nugentii.

Pl. XIII, fig. 5.

"The specimen upon which this variety is founded has no calices, but the transverse views of the corallites are very distinct.

Corallites  $1/3$  inch in diameter, not crowded. Septa in six systems, two cycles in four systems and three in the other two. The tertiary orders are small, and often join the secondary near the columella. The primary septa are square and large at the wall, and not very linear, but staff-shaped within; their width at the margin is  $1/15$  inch. The secondary septa are very much smaller and thinner than the primary, but nearly as large when the tertiary orders are present. Costae wide apart. Exothecal cells scalariform, wider than high; from  $1/30$  to  $1/60$  inch high, and  $1/15$  inch long. Endotheca abundant.

This form has squarer-headed septa, longer exothecal cells, costae wider apart, and a lower septal number than many of the



forms of the species; and differs from the forms with three more or less incomplete septal cycles in the greater thickness of the inner part of the septal laminae, the broad exothecal cells, and in the disposition of the tertiary septa to join the secondary.

From the lithological character of the specimen thus described (Coll. Geol. Soc.), it is either from the Chert-formation of Antigua or from the lower part of the Marl."



*Orbicella crassclamellata* var. *magnifica*.

## Pl. XIII, fig. 3.

"In the smaller corallites of this variety the spear-shaped septa are seen; but in the larger, where there are from twelve to fourteen septa in a system, the primary, secondary, and tertiary orders are nearly equal in size. They have lost the extreme relative thickness between their extremities, and, although still very thin at the columella, they are not greatly developed at the wall. In some corallites the septa, in transverse view, are not straight, but form curving radii\*; and in all, the relation which the septa bear to the interseptal spaces and to the wall is very much exaggerated.

Corallites circular in transverse section; they vary much in diameter, and are now and then crowded, but generally have much coenenchyma between them. The diameters of five corallites are as follows: -- 5/6 inch, 2/3 inch, 1 inch, 1 1/10 inch, 1/2 inch. Walls very indistinct. Costae small, and appearing to be

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\* See a specimen in the Mus. Pract. Geol. Lond.

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appended to all the septa. Exotheca is present, and connects the costae. Septa numerous, especially in large corallites, where the cycles, which are small and rudimentary in the lesser, become well developed. In the smallest corallites there are six systems of four cycles, the fourth and eighth orders being very small. In medium-sized corallites there are six systems, four cycles in five systems, and in the sixth there are the rudimentary sixth, seventh, and eighth orders. The first, second, and third orders are nearly equal in size. In the largest there are six systems, and from twelve to fourteen septa in every system. Lateral teeth exist on all the primary sep'a at the place of greatest width. The higher orders in every system are very linear. Endotheca abundant, but not in excess. Columella large, well developed, and spongy. Coenenchyma formed of cells produced by the costae and the exothecal disseppiments.

This is the largest form of compound Astraean yet described, and when in mass must present a very striking appearance; unfortunately no calices have been discovered as yet. Reproduction by extra-calicular budding.



Marl-formation of Antigua. Coll. Geol. Soc., Mus. Pract.

Geol., and British Museum."



*Pancratia*  
*Orbicella hilli* sp. nov.

Pl. , fig.

Corallum composed of a group of a few large corallites, some of which have prominent calices. The type specimen has a narrow base, is 50 mm. tall, is composed of six corallites, one of which is young; greatest diameter, 52 mm.; lesser, 40 mm. The calices are somewhat constricted, the corallites have greater diameters below them, the diameter of the corallites varying from 16 to 19 mm.; of the calices about 11 mm., some may be compressed, one has a greater diameter of 11, and a lesser of 7 mm. Epitheca extends high up, to near the calices. Externally the corallites are costate, the costae in three sizes, none are especially prominent, but the largest are quite thick, the other smaller according to cycle. They are crowded and have granulated edges.

A smaller specimen with a flattish base has a height of 20 mm.; length, 40 mm.; width, about 30 mm.; it is composed of



5 large and 3 young calices. The calices are not so prominent, nor so divergent as in the type.

There are between 50 and 70 septa, usually with about 12 that are distinctly thicker than the other, the cycles are fairly well indicated. The first and second cycles are nearly equal in thickness, the tertiaries are thinner, the quaternaries and quinaries still smaller. The primaries and secondaries reach the columella, the tertiaries frequently do, and where quinaries are present the quaternaries may. The septa are crowded, their upper margins curved directly from the costae the columella thus obscuring the upper edge of the theca. The costal portions of the septa are the thickest, the decrease in thickness toward the corallite axis is gradual.

Axial fossa slightly sunken but shallow. Columella relatively smaller, occupying about 1/4 the diameter of the corallite cavity; upper surface papillose.



Locality: Island of Antigua, West Indies; R. T. Hill,

Collector.

Geologic horizon: Upper Oligocene.

Type: Museum of Comparative Zoology.

Remarks: This is one of the most sharply defined species of the American Orbicellae. It differs from the O. crassolamellata group by not having wedge shape costae and septa, from the O. cavernosa group by having primary and secondary septa strikingly thicker than those of the higher cycles.



Genus ACTINACIS d'Orbigny.

1849. Actinacis, d'Orbigny, Notes sur des Polyp. foss., p. 11.

1860. Actinacis, Milne Edwards, Hist. nat. corall., t. iii, p. 170.

Type species: Actinacis martiniana d'Orbigny.

I have not been able to study the type species of this genus, but judging from Reuss's figures of A. martiniana<sup>a</sup> the corals here referred to that genus are probably correctly determined.

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<sup>a</sup> Beiträge zur Charakteristik der Kreideschichten in den ostalpen, Wien, 1854, pl. xxiv, figs. 12-15.

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Actinacis bartolomaei, sp. nov.

Pl. . , fig.

1873. Astreaopora panicea, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIX, p. 561.

1899. Astreaopora panicea, Vaughan, Bull. Mus. Comp. Zool.,  
Vol. XXXIV, p. 230.

Non.

1830. Helicopora panicea, de Blainville, Dict. Sci. Nat., t. lx,  
p. 358 = Astreopora panicea Pictet.

Corallum a small mass, depressed, flattish above,  
rounded on the edges. Indications of superimposition of layers.  
Width, 40 mm.; thickness, 21 mm.

Calices small, separated by a very finely reticulate  
coenenchyma from which they are sharply differentiated. Diameter  
1.5 mm. Distance apart variable, but up to the diameter of the  
calices or may be somewhat more. Walls synaptilate and  
perforate.



Septa lamellate, but perforate, rather thick, from 16 or 18 to 24. Primaries separate with secondaries and tertiaries forming groups between. Their margins dentate. Synapticula present. Pali apparently present.

Columella formed by processes from the inner ends of the septa, lax, but quite well developed.

Locality: Island of St. Bartholomew, West Indies, P. T.  
Cleve, Collector.

Geologic horizon: Oligocene, St. Bartholomew limestone.

Type: University of Upsala.

Remarks: The species described above is based on the specimen identified by Duncan as Astraeopora panicea. I do not see why he should have referred it to that species as the two corals do not belong to the same genus. The type specimen is poorly preserved - the septal arrangement could be determined only from a thin section.



Actinacis bartolomaei differs from A. decaturensis by having more septa and there is a more pronounced grouping by three's - the septa in the latter tending rather to be grouped in pairs.



*Actinacis decaturensis*, sp. nov.

Pl. , fig.

Corallum forming large explanate masses, a foot or more across and 70 to 75 mm. thick. Perpendicular section shows a thinly lamellate structure.

Calices small, 1.3 to 1.5 mm. in diameter, usually separated by less than their own diameter of coenenchyma. The coenenchyma is composed of flexures, perforate, granulated costae which are fused into a reticulum by abundant synapticula. The calices are distinctly differentiated from the coenenchyma, but a definite wall is only poorly developed, where it is present it appears to be due to a zone of peripherally disposed synapticula. The costae often lead from one calice to the next, directly across the coenenchyma thus joining the septa of adjacent calices. Septa, slightly less in thickness than the interseptal loculi. The usual number is sixteen, arrangement with refer-



ence to a plane of symmetry. There is some variation from the following plan but it apparently expressed the fundamental condition. At one end of the calice is a solitary directive, the opposite direction forms part of a triplet, a smaller septum fusing to each side of it. Between the solitary directive and the directive-triplet there is on each side three pairs of septa; two pairs, these next the directive-triplet, are fused into a quartet group by the prolongation of the outer septa of the group. The accompanying diagram exhibits these relations. The actual details here given do not occur in all calices, but the presence of a directive plane and the grouping of the septa into pairs, with an occasional triplet is characteristic. Pali occur at the junctions of the inner ends of the septa - there are at least 5. The interseptal loculi are quite open, if any synapticula are present, they are very rare.

Columella quite well developed, composed of septal processes.



Locality: Hale's Landing, 7 miles below Bainbridge, Flint River, Decatur County, Georgia. T. W. Vaughan, Collector.

Geologic horizon: Upper Oligocene, Bainbridge chert.

Type: United States National Museum.

Remarks: The septal arrangement in this species is very similar to that of Porites in the presence of a plane of symmetry and the tendency of the septa to fuse by their inner ends in pairs. The septa themselves, however, are very different, being lamellate, almost imperforate, and sharply differentiated from the surrounding coenenchyma.

Unfortunately the calices of A. bartolomaei are not preserved, and thin sections did not prove so satisfactory as was wished.

Prof. Felix in his "Anthozoen der Gosauschichten in den Ostalpen" <sup>a</sup> has redescribed and figured A. haueri Reuss and A.

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<sup>a</sup> ✓

Palaeontographica, Bd. XLIX, pp. 176-178, figs. 2,3, 1903.

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martiniana d'Orb. He does not speak of the bilateral symmetry of the calices but both of his figures indicate such a condition, in each there are two opposite elongate septa that connect with each other through the columella. I take it then, that the calices of A. martiniana are bilaterally symmetrical with the septa grouped not very definitely in two's, three's, four's or five's on each side of the median plane.

It seems probable that Actinacis may be intermediate in character between the families Acroporidae (Madreporidae Auct.) and Poritidae. These notes and suggestions are made in the hope that some one with the requisite material may make a more careful study of the Cretaceous species of the genus to determine its relations to those two families.



*Astrakelia antiguensis*, sp. nov.

Pl.              fig.

Corallum forming large thick branches that may be more or less palmate. Pl.              figs.              , represent two branches, natural size. The calices are moderately deep, more or less irregular in outline, often subelliptical, the diameter varies from 2 to 4 mm. Their margins elevated about 1 mm., and are distant from one another from 1.5 to 2.5 mm. Somewhat swollen around the base. The coenenchymal surface is plain.

The septal arrangement appears often to be irregular, sometimes two complete cycles and an incomplete third, in many calices the third cycle is complete, and occasionally a few members of the fourth cycle may be present. The absence of the smallest septa undoubtedly is often due to their destruction in fossilization.

Columella very poorly developed, in fact I can not be sure that it is present at all.

Locality.---Morris Lovey's Hill, Antigua, W. I. (R. T.



Hill, Collector), and Russell Spring, Flint River, Decatur County, Georgia.

Geologic horizon.---Basal Upper Oligocene.

Types.---United States National Museum.

Remarks.---A careful comparison of the specimens from near Bainbridge, Georgia, with the smaller specimens from Antigua, fails to reveal any difference whatever between the specimens.



Astridella portoricensis, sp.nov.

Pl. , figs.

Corallum ramosa, branches subcircular or elliptical in cross-section. Length of type, 56 mm.; greater diameter of lower end, 16 mm., lesser, 13 mm.; width of upper end (which is bifurcating) about 30 mm.

Calices, moderately deep, usually deformed, one diameter longer than the other. A small calice has a greater diameter of 1.7 mm., lesser, 1.3 mm.; a rather large calice has diameters measuring 2.3 and 1.6 <sup>mm.</sup> respectively. The distance apart of the calices varies from 1.3 to slightly more than 2 mm. Calicular margins scarcely elevated -- there is ~~really~~ no distinctly elevated rim. Coenenchymal surface corroded -- apparently there are low costae and small granulations.

Septa, in the larger calices, in three cycles, the last very small; their outer ends thick, the inner portions thin. Upper margins very slightly exsert. Margins dentate.



*Astrrhelia portoricensis*

Columella, poorly developed.

Locality: 4 miles west of Lares, Porto Rico; R. T.  
Hill, Collector.

Geologic horizon: Upper Oligocene, Pepino formation.

Type: No. United States National Museum.



Genus GONIOPORA de Blainville.

1816. Astrea (pars), Lamarck, Hist. nat. anim. sans vert., t. ii, p. 257.
1830. Goniopora, de Blainville, Dich. scâ. nat., t. lx, p. 359.
1834. Gonicopora, Quoy and Gaimard, Voyage de l'Astrolabe, t. iv, p. 218.
1849. Litharaea, Milne Edwards & Haime, Comptes Rend., t. xxix, p. 258.
1849. Goniopora, Milne Edwards & Haime, Comptes Rend., t. xxix, p. 259.
1849. Rhodaraea, Milne Edwards & Haime, Comptes Rend., t. xxix, p. 259.
1849. Poraraea, Milne Edwards & Haime, Comptes Rend., t. xxix, p. 259.
1886. Tichopora, Quelch, Reef Corals, Challenger Reports, p. 188.
1903. Gonippora, Bernard, Catal. Madrep. Corals, Brit. Mus. (Nat. Hist.), vol. iv, Genus Goniopora, pp. 1-206, pls. xiv.



The synonymy given above is taken from Bernard's Catalogue of the "Genus Goniopora", which contains by far the most elaborate discussion of the genus as yet published. Those who desire more information should consult that work.

Previous to the present time only one undoubted species of Goniopora had been described from America, the Porites reussiana Duncan, from Jamaica and of supposed Cretaceous age (for description, see p. , infra). Bernard apparently overlooked this species as it is omitted from his catalogue. There is another species that may be a Goniopora, the Stephanocoenia tenuis Duncan, from the Island of Antigua, West Indies, of which Rhodraea irregularis Duncan from the same locality is a synonym (for description, see p. , infra).

To these I am able to add six different kinds of Gonioporae which are treated as "species", and to one of these three "varieties" are appended. They are:



From St. Bartholomew, West Indies:

*Goniopora bartolomaei* sp. nov. = *Porites ramosa* Duncan  
(non Catullo).

*antillarum* sp. nov. = *Actinacis rollei* Duncan  
(non Reuss)

From Bowden, Jamaica,

*Goniopora bowdenensis* sp. nov.

From Florida:

*Goniopora tampaensis* sp. nov.

*calhounensis* sp. nov.

From Flint River near Bainbridge, Georgia.

*Goniopora decaturensis* sp. nov.

var. *silicensis* nov.

var. *caeruleifontis* nov.

var. *bainbridgensis* nov.

The collections that I have been able to study are too small for me to determine positively whether all the forms recognized are or are not really distinct species. The "species"



are described according to localities, and critical remarks are appended. This small group of corals is one that shows especially well the urgent necessity for much more extensive collections and more detailed study before we define the limits of many of the species and discover the relations between the faunas of the various horizons.



Cretaceous? of Jamaica.

*Goniopora reussiana* (Duncan).

Pl. figs.

1865. *Porites reussiana*, Duncan, Quart. Jour. Geol. Soc. London,  
vol. xxi, p. 8, pl. I, fig. 2.

1867. *Porites reussiana*, Duncan, Quart. Jour. Geol. Soc. London,  
vol. xxiv, p. 25.

1899. *Porites reussiana*, Vaughan, Full. Mus. Comp. Zool., vol.  
xxxiv, p. 249.

Original Description.

"The corallum is in more or less cylindrical branches, which leave the stem at an acute angle, and are often flattened, and always rugged and gibbous. The calices are large, irregular in size, and shallow. The columella is small, and there are sometimes more than six distinct pali. The septa are from eight to twenty-four in number. Diameter of calices often 2.5 mm.; that of the branches from 15 to 33 mm.

"Locality. Upper Clarendon District, Jamaica."



I saw the type in the collection of the Geological Society of London in January 1898 and again in October 1903. The usual number of cycles of septa is three; the arrangement into cycles does not appear perfectly regular and uniform, so Duncan's figures must be used with a qualification. In the best preserved portions there is no granulate area on the summit of the wall between the ends of the septa; the upper edge of the wall apparently is acute in perfect material. Diameter of the calices 2.5 to 4 mm.; the usual diameter is slightly less than 3 mm. The details of the pali could not be made out. It is very doubtful if they were distinctly differentiated.

The coral is a Goniopora, a ramous form of Milne Edwards and Haime's Litharaea. Two figures of the type are given on pl. , figs. .

Geologic horizon: Upper Cretaceous?

For critical remarks see *G. bartolomaei*, p. infra.



Oligocene of St. Bartholomew, West Indies.

Gonicpora bartolomaei sp. nov.

Pl. fig.

1873. Porites ramosa, Duncan, Quart. Jour. Geol. Soc. London,  
vol. xxix, p. 561.

1899. Porites ramosa, Vaughan, Bull. Mus. Comp. Zool., vol.  
xxxiv, p. 230.

Non.

1856. Porites ramosa, Catullo, Terr. Sediment. sup. Venezie  
Antozoari, p. 77, pl. xvii, fig. 6 A. B.

1900. Porites ramosa, Vaughan, U. S. Geol. Surv. Mon. xxix, p.  
195, pl. xxiii, figs. 4, 5, 6, = Ocellaria  
ramosa Lonsdale, Quart. Jour. Geol. Soc.  
London, vol. I, p. 510, 1845.

Corallum very strongly lobate, the lobes compressed,  
crowded together, with rounded ends. The type specimen is a  
broken specimen, about 57 mm. tall, greatest length of base 54  
mm., width of base 36 mm. Two rather wide, compressed lobes, with



their inner faces almost touching rise above the base. Pl.

figs. , gives two views, natural size of the specimen.

Calice, hexagonal, shallow, walls narrow, mostly acute on the edge, not prominent. Diameter usually 3.6 mm.

Septa distinctly lamellate, but perforate; thick, especially near the wall. The usual number is 24. The grouping is in triplets, with a free septum between each triplet - as the surfaces of the calices have been damaged, as much detail as was desired concerning the calices could not be ascertained. The highest cycle of septa may extend for a considerable distance into the calicular cavity - half the length of the larger septa or even more. Septal margin dentate. Interseptal loculi narrow, coarse synapticula abundant. It is very doubtful if any pali were ever present, however, granulations or dentations not differentiated from those of the septal margins correspond in position to pali.

Columella tangle moderately developed.



Locality. Island of St. Bartholomew, West Indies, P. T.

Cleve, Collector.

Geologic horizon: Oligocene, "Limestone of St. Bartholomew."

Type: A single specimen, University of Upsala.

Remarks: This species is most closely related to *G. reussiana* (Duncan) (supra, p. ). The most noticeable difference is in the form of the corallum, the corallum of the former consists of compressed, ascending lobes, while that of the latter actually branches. The calices of both are of nearly the same size, depth, &c. Each species is based on a single not very well preserved specimen, and I have not been able to compare them directly.



## Goniopora antillarum sp. nov.

Pl. figs. .

1873. Actinacis rollei, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XXIX, p. 561.

1899. Actinacis rollei, Vaughan, Bull. Mus. Comp. Zool., Vol.  
XXXIV, p. 230.

Non Actinacis rollei, Reuss, Denkschr. K. K. Akad. Wiss.  
Wien, Math. - Naturhist. Cl., Bd. xxiii, p.  
27, pl. viii, fig. 6, 1864.

Corallum forming an elongate somewhat compressed mass,  
with calices distributed over all the surface, except on one  
broken end; it therefore seems quite probable that corallum grew  
erect attached by a comparatively small base. The type specimen  
is 120 mm. long, 67 mm. wide, and 47 mm. thick. The surface is  
somewhat irregular, with faint humps and slight depressions.

Calices polygonal, rather deep or shallow, separated by  
distinct, moderately thick walls, .5 to 7.5 mm. thick. The



calices are variable in size, the largest 3 mm., the smaller ones about 1.75 mm. in diameter; 2.5 mm. seems to be the average.

Septa, usually 24 in number, with the mode of fusion characteristic of the genus. They are crowded, comparatively thick, with narrow interseptal spaces. Septal margins rather finely beaded. Synapticula abundant, several rows occur alongside one another where the walls are thick. There are no distinct pali, but some of the septal dentations around the columella may be slightly larger than the other dentation.

Columella tangle not greatly developed.

Locality: Island of St. Bartholomew, West Indies, P. T.

Cleve, Collector.

Geologic horizon: Oligocene, "Limestone of St. Bartholomew."

Type: A single specimen, University of Upsala.

Remarks: This species stands alone, its mode of growth being strikingly different from that of any of the other Gonioporae.



Oligocene of Antigua, West Indies.

Goniopora ? tenuis (Duncan).

Pl. ,figs. .

1863. Stephanocoenia tenuis, Duncan, Quart. Jour. Geol. Soc.

London, Vol. XIX, p. 423, Pl. XIV, figs. 3a,3b.

1863. Rhodarea irregularis, Duncan, Quart. Jour. Geol. Soc. London,  
Vol. XIX, p. 426.

1866. Stephanocoenia tenuis, Duchassaing & Michelotti, Sup. Mem.  
Corall. Antilles, p. 75 (of reprint).

1867. Stephanocoenia tenuis, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 23.

1867. Rhodarea irregularis, Duncan, Quart. Jour. Geol. Soc.  
London, Vol. XXIV, p. 25.

1870. Stephanocoenia tenuis, Duchassaing, Rev. Zoop. Antilles,  
p. 27.

1903. Goniopora ? Antigua(1), Bernard, Brit. Mus. (Nat. Hist.)  
Cat. Madrepor., Vol. IV, p. 155, Pl. XIV,  
fig. 17.



Bernard has carefully redescribed Duncan's type in his Catalogue of "The Genus *Goniopora*" (op. sup. cit.). The following is his description:

Description;---Corallum massive, with polygonal calicles running straight, side by side, as nearly open tubes about 3.5 mm. in diameter. Walls thin, membranous, apparently perforate, very zigzag, sometimes forming a delicate angular, but open-meshed, reticulum when seen from above. The 24 septa are very thin, and the primaries and secondaries meet in a large open columellar tangle. The tertiaries appear to end freely.

"There is only one specimen, silicified throughout, and with the coral imbedded in the clear matrix. But there are reasons to doubt whether the original conditions have been preserved, and also whether it is a Goniopora at all. The thin zigzag walls and the septa are nowhere sharply defined when seen under a pocket-lens, and what appear to be the apertures in the walls have ragged irregular outlines. It looks as if the substance of the coral



skeleton had been etched away; and, if so, there is a possibility of these apertures being secondary and accidental, and this alone would rule the specimen out of this genus. It is also characteristic of the Poritidae that the bases of the calicles fill up with tissue so as to be only occasionally traceable through the corallum. Here they are long open tubes. Then, again, it is very rare to see the tertiary septa end freely, and, as a rule, it is not like Goniopora to have such rigid septa. There is a fluency in the skeleton of this genus, with hardly a single exception, which is in great contrast to the skeletal rigidity shown in this fossil; such subtle indefinable distinctions are often excellent guides. But even in the face of these difficulties we have to be true to our morphological analysis; and from this point of view I think that, on the whole, the balance of the direct structural evidence is in favor of its being a Goniopora: the thin zigzag membranous walls, occasionally forming a reticulum, the large columella, the 24 septa, are all so much positive evi-



dence, while the existence of the pores in the walls points also in the same direction. The difficulties can perhaps be regarded as mere questions of degree.

"The specimens belonging to the Geological Society are from the "Marl formation, the Inclined Beds and Chert" of Antigua, and from "the Silt of the Sandstone plain," San Domingo. They were placed by Duncan in the genera Stephanocoenia and Rhodaraea; with the former identification I can not at all agree."

Geologic horizon.---Upper Oligocene.

Additional collections must be made in Antigua and they must be carefully studied before a decision can be reached as to what this coral really is.



Oligocene of Jamaica.

Goniopora bowdenensis sp. nov.

Pl. , fig. .

Corallum light, forming a low mass, consisting to some extent of layers growing one over another. Upper surface unevenly rounded, lower surface with a large area of attachment in the middle, there is a narrow free edge in places above it, wherever there is a free edge the under surface is epithecate. Greatest width of type 64 mm.; height 36 mm.

Calices shallow, over the whole upper surface and extending to the edges which in places are curved downward on the base. Their cutline hexagonal, diameter 2 to 3 mm. Wall, where not damaged, has an acute upper edge, but is not prominent; in worn calices it is quite thick, composed of about three rows (or zones) of synapticula.



Septa, 24 in number, with an arrangement exactly the same as that given by Bernard in his Catalogue of "The Genus Goniopora."<sup>a</sup> There are two directive septa which form a plane of symmetry across the calice. The tertiaries fuse to the sides of the secondaries. On each side of the plane of symmetry, there is at one end of the calice a triplet composed of a secondary and two tertiaries fused to its sides, this secondary does not fuse to a primary. The septa of the two other systems on the same side form two quartets. The tertiaries fuse to the secondaries as just described, but the secondary fuses by its inner end to the inner end of the primary (See Pl. , figs. , for a photographic illustration of the condition, and also a diagram.). The septa are rather thick, as thick as or thicker than the width of the interseptal loculi. The septal margins are rather closely

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<sup>a</sup>

Cat. Madrep. Cor. Brit. Mus. (Nat. Hist.), vol. iv, the Genus Goniopora, 1903, p. 21, fig. 1A.

---



and delicately dentate. On the sides of the septa are numerous granulations; synapticula are quite abundant. There are no pronounced pali, but the dentations around the columella may be somewhat larger than the others.

Columella tangle distinct, variable in size.

Locality: Bowden, Jamaica, R. T. Hill, Collector.

Geologic horizon: Oligocene, Bowden horizon.

Type: Museum of Comparative Zoology; fragment in United States National Museum.

Remarks: This species is most closely related to G. calhounensis (p. , infra), from which it is distinguished by having thicker septa and smaller calices.



Oligocene of Florida.

Goniopora tampaensis sp. nov.

Pl. , figs.

Corallum subovate in form, 43 mm. long, 32 mm. wide, and about 24 mm. thick. Upper surface rounded with some slight irregularities. Beneath there appears to be a rather large attachment area.

Calices moderately excavated, distributed over all the surface above the attached area. Their outline polygonal, not very regular in shape or size. Usual diameter 3.5 mm., a large calice is 4 mm., a small one only 2 mm. Walls appear when not damaged to be acute on the summits, but in some instances they might originally have been rounded. They are quite thick, as much as 1 mm., and are unusually compact.

Septa in three cycles, thicker at the walls, becoming thinner toward the center of the calice. They also are thinner



along the edge than further down. The septal margins are rather regularly dentate, 6 or 7 teeth occurring on the longer septa, the innermost dentations may be somewhat larger than the others and quite paliform in appearance. Septal faces granulate and synapticula are abundant, especially in the mural region where they are stout.

Columella tangle well developed and is decidedly compact in appearance.

Locality: Ballast Point, Hillsboro' Bay, near Tampa, Florida.  
also Island of Anquilla, P. T. C. Co. West Indies, P. T. Cleve, Collector.

Geologic horizon: Upper Oligocene, Tampa Sikek bed horizon.

Type: A single specimen, United States National Museum.

Remarks: *G. tampaensis* differs from *G. californiensis* by having deeper calices and a coarser texture.



*Goniopora calkounensis*, sp.nov.

Pl. , figs. .

Corallum, with a rather delicate, fragile, texture, forming very light head-shaped masses - the largest has a diameter of 115 mm. and a height of about 70 mm. The upper surface is quite regularly rounded. The lower surface may be concave. There is evidence of the coral forming in strata, the newer layers being separated from the older by epitheca.

Calices somewhat excavated, distributed over the whole of the upper surface of the edge of the epitheca. Their outlines polygonal, ranging in diameter from 2.75 to 4.5 mm. The walls are quite thick, composed of numerous rows of synapticula joining the septa together.

The septa are thin, not equal in thickness to the width of the interseptal loculi. The normal number is three complete cycles, but in one abnormally large calice there are over thirty. Delicate synapticula very numerous.



Columella tangle rather large, composed of delicate processes.

Locality: One mile below Bailey's Ferry, Chipola River, Calhoun County, Florida.

Geologic horizon: Upper Oligocene, Chipola horizon.

Type: United States National Museum. There is the type specimen and 4 fragments.



Oligocene of Georgia.

Goniopora decaturensis sp.

Pl. , figs.

Corallum lamelliform or with a lateral expansion far exceeding its thickness. The specimen selected as the type is a portion of a corallum, 90 mm. across and about 23 mm. thick. Another specimen is 49 mm. long; 35 mm. wide; and 7.5 mm. thick. The upper surface is plane or undulate. When the corallum is foliaceous it may be irregularly flexed.

Calices shallow, superficial or only slightly excavated. Polygonal, the usual diameter 2 $\frac{1}{2}$  to 3 mm. The wall when somewhat worn usually has a membraniform appearance, being almost continuous, interrupted in places, but forming a quite distinct boundary between adjacent calices. In other instances there may be no well defined boundary to the calices. In the peripheral portion of the interseptal loculi frequently two rows of synapticula reinforce the wall.



Septa of variable thickness on the same specimen, usually moderately stout; on the thinner lamellae they are quite thick. The thickness of the septa seems to be correlated with the thickness of the colony. When the corallum is thick the septa are thin and vice versa. The normal number is 24, though there are in some places a few less, in others a few more. The usual arrangement is six primaries extending directly to the axis, with a triplet group of secondary and two tertiaries between each pair. A directive plane could be observed in some calices, but the septa are too much damaged to permit discovering all the details of the arrangement. The margins are dentate, five to seven dentations on each longer septum. The faces with the usual granulations. Synapticula quite abundant, but not greatly crowded, variable in thickness.

Columella tangle well developed.

The texture of the corallum is of variable firmness, depending upon the thickness of the septal trabeculae, the synapticula, &c., however, it seems never to be especially dense.



Localities: Blue Springs, 5 miles below Bainbridge, and Hale's Landing, 7 miles below Bainbridge, Flint River, Decatur County, Georgia. T. W. Vaughan, Collector.

Geologic horizon: Upper Oligocene, Bainbridge Chert horizon.

Type: United States National Museum.

Besides the lot of specimens referred to the species described above three other types or Rinds of Goniopora occur on the Flint River at Blue Springs and Hale's Landing. It is impossible with the material at hand to decide whether they are distinct species or only varieties or formae of G. decaturensis. However, as it seems very probable that they are only varieties they are named and described as such.



*Goniopora decaturensis* var. *silicicola* var. nov.

Pl. , fig.

This is a specimen 113 mm. long, 54 mm. wide and 20 mm. thick. The upper surface is slightly undulated, there is one deep depression but it may have been caused by a burrowing animal or may have been corroded.

The calices are larger than in typical *G. decaturensis* 2.5 to 4 mm. in diameter. The septa are decidedly thin and the texture light and fragile.

This specimen is quite similar to *G. calhouensis*, its difference consisting mostly in that of form.

Locality: 5 miles below Bainbridge, Georgia.

Geologic horizon: Upper Oligocene, Bainbridge chart.

Type: United States National Museum.



*Goniopora decaturensis* var. *caeruleifontis* var. nov.

Pl. fig.

This is a small specimen, apparently attached by its whole lower surface, and rounded above. Length 18.5 mm., width 13.5 mm., thickness 7 mm.

Calices excavated, 3 mm. in diameter, distinctly demarcated by membraniform walls. Upper edge of wall usually acute.

Septa thin, with delicately dentate margins.

This specimen resembles very closely *G. tampaensis*, differing from the latter by having thinner walls and thinner septa.

Locality: Blue Springs, 5 miles below Bainbridge, Flint River, Georgia.

Geologic horizon: Upper Oligocene, Bainbridge Chert.

Type: United States National Museum.



*Goniopora decaturensis* var. *bainbridgeensis* var. nov.

Pl. figs.

Two small specimens inflated and rounded above, are referred to this variety. No. 1, length, 26.5 mm., width 25 mm., thickness, 13.5 mm.; No. 2, length 35 mm., width 24 mm., thickness 19 mm.

Calices superficial, about 3 mm. in diameter.

Septa moderately thick.

These specimens are separated from typical G. decaturensis solely on the growth form.

Locality: Blue Springs, 5 miles below Bainbridge, Georgia.

Geologic horizon: Upper Oligocene, Paintridge Chert.

Types: United States National Museum.



Gonicpora clevei sp. nov.

Pl. , figs.

Corallum branching. The type is an irregularly shaped portion of a branch, selected because it permits the septal arrangement to be definitely determined. It is 44 mm. long, greater diameter of lower end 18 mm.; of bulged portion 15.5 mm. Probably some of the irregularity of form may be caused by erosion. Another broken specimen not considered the type is represented by Pl. , fig. .

Calices shallow, circular or subcircular, 1.5 mm. in diameter. They may be close together or separated by reticulate and costate coenenchyma, as much as 1 mm. across; usually they are distinctly separated from the bounding coenenchyma and sharply defined by a peripheral zone of synapticula.

There are twelve large septa with typical poritid arrangement - solitary direction, four lateral pairs and a directive triplet, the inner ends of the laterals in the triplet are



directed toward but not actually fused to the inner end of the principal directive. The outer ends of these larger often are bifurcated, or costae (probably to be considered rudimentary septa) exist between them, in some instances bringing the number up to 24. Pali quite well developed, six in number.

Columella tangle rather dense, with axial tubercle.

Locality: Island of Anguilla, West Indies, P. T. Cleve,  
Collector.

Geologic horizon: Upper Oligocene.

Type: University of Upsala.

Remarks: It was decidedly ~~presenting~~<sup>difficult</sup> to decide whether this species should be referred to Porites or Goniopora. I have used in making the decision a criterion proposed by Bernard: "These fossils with 12 central rays might almost be considered as transition forms toward Porites, having to all appearance only 12 septa; but whenever it can be distinctly seen that a certain



number of these septa fork before they reach the wall, I assume that the forking is the vestige of the fusion of the septa characteristic of Goniopora, and that therefore there are more than 12."<sup>a</sup>

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a Cat. Madrep. Corals, Brit. Mus., vol. iv, Gen.  
Goniopora, p. 21.

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Goniopora portoricensis sp. nov.

Pl. , figs.

Corallum ramous, branches rounded in cross-section or  
~~decidedly~~  
very compressed, a branch of the taller form is 34 mm. wide, with  
a maximum thickness of about 9 mm.

Calices polygonal, shallow, usual diameter 2 mm. The  
outer ends of the septa are flattened and fused together, sepa-  
rating the calicular depressions by a wall about .5 mm. thick.

Septa delicate, very perforate, in three complete cycles.  
Pali appear to be poorly developed, not specially differentiated  
from the ordinary septal dentations.

Columella weakly developed.

Locality: 4 miles west of Lares, Porto Rico. R. T.  
Hill, Collector.

Geologic horizon: Upper Oligocene, Pepino formation.

Types: No. United States National Museum.



Porites anguillensis sp. nov.

Pl. figs.

Corallum composed of thin laminae, more or less undulate, resting one on another, but still separate. The underside epithecate to the edge, the epitheca minutely, regularly and concentrically striate. The type specimen consists of two such laminae, both broken. The greatest thickness of the two is about 15 mm., the greatest width 58 mm. One lamina is 5 mm. in its thicker portion, with a thin edge.

The calices are shallow, subcircular, 1.7 to 2.3 mm. in diameter, separated by flat coenenchymal walls .8 to 1 mm. across. The coenenchyma is perforate, but rather compact and costate.

Septa, rather thick, normal number 12, with solitary directive, four lateral pairs, and with the laterals on the sides of the principal directive loosely fused to it or continued to the columella tangle. Pali, usually six in number, before



the lateral pairs, on the ends of the solitary and principal directives. Usually a prominent dentation at the inner edge of the wall. Synapticula well developed, three rows in the wall, and a ring of thick ones, coinciding with the palar ring, around the axis of each corallite. Trabeculae of columellar tangle coarse; axial tubercle present.

In longitudinal section there are in 3.5 mm. about 11 synapticula, in the same distance about 10 vertical rods. The spaces of approximately the same thickness as the solid parts, except the median portion of a synapticulum is thinner, than its ends.

Locality: Island of Anguilla, West Indies, P. T. Cleve,

Collector.

Geologic horizon: Upper Oligocene.

Type: University of Upsala.



**Porites** sp. *Anguilla.*

Pl. , fig.

A detailed description of this coral, represented by two specimens, could not be drawn up, but still it seems worth noticing.

The corallum small, grows as a thin lamina, various curled, with calices on one side. Maximum thickness 3.5 mm. General views of the two specimens are given on pl. , figs.

Calices 1.5 to 2 mm. in diameter.

Septa -- arrangement could not be made out.

Locality: Island of *Anguilla*, West Indies, P. T. Cleve,

Collector.

Geologic horizon: Upper Oligocene.

Specimens: 1 in University of Upsala; 1 in United States National Museum.



Alveopora regularis Duncan.

Pl. , fig.

1863. Alveopora daedalea Blanv., var. regularis, Duncan, Quart.  
Jour. Geol. Soc. London, vol. xix, p. 426.

Other reported sp. of Alveopora

A. annularis Duncan

A. fimbriata Duncan



*Alveopora microscopica* Duncan.

Pl. fig.

1863. *Alveopora microscopica* Duncan, Quart. Jour. Geol. Soc.  
London, vol. xii, p. 426.



*Alveopora tampae* sp. nov.

Pl. , fig.

(Description to be written later.)

Locality: Ballast Point, Tampa Bay, Florida (W. H. Dall).

Geologic horizon: Upper Oligocene, Tampa Silex bed.

Type: United States National Museum.

















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